

UMASS/AMHERST



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FORTY-NINTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

FOURTEENTH ANNUAL REPORT OF THE HATCH EXPERI-
MENT STATION OF THE MASSACHUSETTS
AGRICULTURAL COLLEGE.

1901.



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TABLE OF CONTENTS.

| | PAGE |
|--|------|
| State Board of Agriculture, 1902, | v |
| Report of the Secretary, | vii |
| Minutes of Meetings of Executive Committee, | 3 |
| Summer Meeting of the Board at South Swansea, | 7 |
| Address: The Influence of the Monks in Agriculture. By Dr. H. H. Goodell, | 8 |
| Address: The Culture of the Civic Virtues. By Rev. Calvin Stebbins, | 28 |
| Public Winter Meeting of the Board at Northampton, | 41 |
| Lecture: Modern Potato Culture. By Dr. Chas. D. Woods, | 45 |
| Lecture: The Shade-tree Insect Problem. By A. H. Kirkland, M.S., | 77 |
| Lecture: Dairying in France. By Maj. Henry E. Alvord, | 121 |
| Lecture: The Latest Results of Experiments in the Culture, Cure and Fermentation of Tobacco. By Dr. E. H. Jenkins, | 139 |
| Lecture: Dairy Economics. By Ex-Gov. W. D. Hoard, | 168 |
| Lecture: Nature Study and the Need of Agriculture in a System of Public Education. By C. F. Hodge, Ph. D., | 200 |
| Lecture: The Relation of Fruit Culture to the Value of New England Farms. By Prof. George T. Powell, | 232 |
| Lecture: The Colored Race and its Relation to the Productive Industries of this Country. By Dr. Booker T. Washington, | 255 |
| Minutes of Annual Meeting of the Board, | 281 |
| Minutes of Special Meeting of the Board at Boston, | 295 |
| Report of Committee on Agricultural Societies, | 298 |
| Report of Committee on Domestic Animals and Sanitation, | 299 |
| Report of Committee on Experiments and Station Work, | 301 |
| Report of Committee on Forestry, Roads and Roadside Improve- ments, | 302 |
| Report of Committee on Agricultural College and Education, | 305 |
| Report of Committee on Institutes and Public Meetings, | 310 |
| Report of Committee on Gypsy Moth, Insects and Birds, | 313 |
| Report of the Librarian, | 320 |
| Essay: Massachusetts Forestry. By Hon. Wm. R. Sessions, | 322 |
| Essay: The Influence of the Board on the Agriculture of the State. By John Bursley, | 331 |
| Report of Delegates to the Farmers' National Congress, | 336 |

| | PAGE |
|--|------|
| Essay: Three Common Orchard Scales. By Dr. Henry T. Fernald, | 353 |
| Essay: A Lesson in Economics: what the Agriculture of the Twentieth Century demands. By Dr. G. M. Twitchell, | 364 |
| Essay: Selection and Improvement of the Dairy Herd. By Prof. F. S. Cooley, | 377 |
| Essay: Cranberry Culture in South-eastern Massachusetts. By John Bursley, | 389 |
| Essay: Irrigation in Humid Climates. By Prof. C. S. Phelps, . . | 398 |
| Essay: Poultry Keeping as a Principal Feature of Diversified Farming. By John H. Robinson, | 416 |
| Eleventh Annual Report of the State Dairy Bureau, | 433 |
| Abstract of Report of Board of Cattle Commissioners, | 459 |
| Returns of the Agricultural Societies, | 502 |
| Agricultural Directory, | 513 |
| Index, | 531 |

STATE BOARD OF AGRICULTURE, 1902.

Members ex Officio.

HIS EXCELLENCY W. MURRAY CRANE.

HIS HONOR JOHN L. BATES.

HON. WM. M. OLIN, *Secretary of the Commonwealth.*

H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*

C. A. GOESSMANN, Ph.D., LL.D., *Chemist.*

AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*

JAMES W. STOCKWELL, *Secretary.*

Members appointed by the Governor and Council.

| | Term Expires |
|---|--------------|
| FRANCIS H. APPLETON of Peabody, | 1903 |
| WARREN C. JEWETT of Worcester, | 1904 |
| WILLIAM R. SESSIONS of Springfield, | 1905 |

Members chosen by the Incorporated Societies.

| | | |
|--|--|------|
| <i>Amesbury and Salisbury (Agr'l and Hort'l)</i> , | { F. W. SARGENT of Amesbury, | 1903 |
| <i>Barnstable County</i> , | JOHN BURSLEY of West Barnstable, | 1904 |
| <i>Berkshire</i> , | WESLEY B. BARTON of Dalton, | 1903 |
| <i>Blackstone Valley</i> , | SAMUEL B. TAFT of Uxbridge, | 1903 |
| <i>Bristol County (delegate-elect)</i> , | WILLIAM A. LANE of Norton, | 1905 |
| <i>Deerfield Valley</i> , | ARTHUR A. SMITH of Colrain, | 1905 |
| <i>Eastern Hampden</i> , | O. E. BRADWAY of Monson, | 1903 |
| <i>Essex</i> , | { JOHN M. DANFORTH of Lynnfield (P.O. Lynnfield Centre), | 1905 |
| <i>Franklin County</i> , | JOHN S. ANDERSON of Shelburne, | 1904 |
| <i>Hampshire</i> , | A. M. LYMAN of Montague, | 1904 |
| <i>Hampshire, Franklin and Hampden</i> , | H. C. COMINS of Northampton, | 1903 |
| <i>Highland</i> , | C. K. BREWSTER of Worthington, | 1905 |
| <i>Hillside</i> , | J. W. GURNEY of Cummington, | 1905 |
| <i>Hingham (Agr'l and Hort'l)</i> , | EDMUND HERSEY of Hingham, | 1903 |
| <i>Hoosac Valley</i> , | { GEO. P. CARPENTER of Williamstown (P. O. Blackinton), | 1903 |
| <i>Housatonic</i> , | CHARLES B. BENEDICT of Egremont, | 1903 |
| <i>Man'sf'ts' Agr'l (No. Attleborough)</i> , | OSCAR S. THAYER of Attleborough, | 1903 |
| <i>Marshfield (Agr'l and Hort'l)</i> , | HENRY A. TURNER of Norwell, | 1903 |
| <i>Martha's Vineyard</i> , | JOHNSON WHITING of West Tisbury, | 1904 |
| <i>Massachusetts Horticultural</i> , | WM. H. SPOONER of Jamaica Plain, | 1903 |
| <i>Massachusetts Society for Promoting Agriculture</i> , | { N. I. BOWDITCH of Framingham, | 1903 |
| <i>Middlesex North</i> , | { JOSHUA CLARK of Tewksbury (P. O. Lowell), | 1904 |
| <i>Middlesex South</i> , | { ISAAC DAMON of Wayland (P. O. Cohituate), | 1905 |
| <i>Nantucket</i> , | J. S. APPLETON of Nantucket, | 1903 |
| <i>Oxford</i> , | W. M. WELLINGTON of Oxford, | 1904 |
| <i>Plymouth County</i> , | { AUGUSTUS PRATT of North Middleborough, | 1905 |
| <i>Spencer (Far's and Mech's Assoc'n)</i> , | JOHN G. AVERY of Spencer, | 1904 |
| <i>Union (Agr'l and Hort'l)</i> , | ENOS W. BOISE of Blandford, | 1904 |
| <i>Weymouth (Agr'l and Ind'l)</i> , | QUINCY L. REED of South Weymouth, | 1903 |
| <i>Worcester</i> , | J. LEWIS ELLSWORTH of Worcester, | 1905 |
| <i>Worcester East</i> , | W. A. KILBOURN of South Lancaster, | 1903 |
| <i>Worcester North-west (Agr'l and Mech'l)</i> , | { T. H. GOODSPEED of Athol (P. O. Athol Centre), | 1904 |
| <i>Worcester South</i> , | C. D. RICHARDSON of West Brookfield, | 1904 |
| <i>Worcester County West</i> , | J. HARDING ALLEN of Barre, | 1905 |

THE FORTY-NINTH ANNUAL REPORT
OF THE
SECRETARY
OF THE
BOARD OF AGRICULTURE.

*To the Senate and House of Representatives of the Commonwealth
of Massachusetts.*

Dr. Pritchett said in an address before the Board of Agriculture: "The farmer must avail himself freely of the results of modern science, if he is to keep pace with the developments in manufactures, in mining and in other directions. A whole series of facts relating to the soil, to the climate, to the life of plants, of insects, to the rotation of crops, are available for his use. The applications of chemistry and botany and geology and zoölogy bear directly upon his work. . . . The twentieth-century farmer must use his head as well as his hands, if he is to keep step with progress, and this will be apparent if we consider the fact that agriculture has failed to advance as rapidly in the past few decades as manufactures, mining or population. . . . The fact that agriculture has not kept pace either with population or with other branches of industry, is one that concerns not only those who live on farms, but it concerns as well the whole country."

This is not a new proposition of Dr. Pritchett,—it is a fundamental fact. It was the inspiration to the organization of this Board fifty years ago. It is the justification of the interest of the State in this Board to-day, and on the same foundation of its productive industries must the wealth of the State and nation rest when the century shall grow old and die. We come to our council chamber to-day in annual session realizing the advance in the years past in

which we have had some part, and rejoicing in the prosperity the year has brought to the State, to the farms and to the homes of Massachusetts.

CHANGES IN THE BOARD.*

As heretofore, changes in membership resulting from elections by the several societies will be noted in the report of the committee on credentials in the proceedings of the annual meeting.

Members retiring at this time because of expiration of term of service are: Alvan Barrus of the Hillside Agricultural Society, Charles A. Gleason of the Worcester County West Agricultural Society and Edward M. Thurston of the Bristol County Agricultural Society. There have been no changes the past year because of death or resignation.

MEETINGS OF THE BOARD.

A summer field meeting of the Board was held at South Swansea, at the residence of Mr. E. M. Thurston, Aug. 23, 1901. The public winter meeting for lectures and discussions was held at Northampton, Dec. 3-5, 1901. The annual business meeting was held at the office of the secretary, Jan. 7 and 8, 1902.

AGRICULTURAL SOCIETIES.

The duties of the several agricultural societies to the Board of Agriculture and to the State are of a serious character, and demand the best work of each society. The societies receive from the State encouragement and support, not for the benefit of the society as a society, but for the improvement and upbuilding of agriculture within its borders. The productive industries of a State or nation are its strength, and above all other industries in importance and amount are the agricultural productions. This is attested by the fact that for a series of years eighty per cent of our exports have been agricultural, bringing to the treasury of these United States the gold that indicates the nation's prosperity. The State was wise in its foresight fifty

* By chapter 116, Acts of 1902, a Cattle Bureau of the Board of Agriculture is established, the chief of said Bureau becoming a member of the Board.

years ago in instituting this Board of Agriculture, and is wise in the encouragement of agriculture to-day; and the marked advance of agricultural prosperity in this last decade is the most encouraging feature of the present outlook.

In return for this encouragement and this financial help the societies owe something to the State, and, for the good of all, each individual society is bound to do its best work in every line marked out by the Board of Agriculture acting under the laws of the State.

And, first, the duty is imminent and important that the societies shall select for membership on this Board their best representatives. The State expects this, and the strength and character of the Board rests largely in the hands of the societies.

Second, the institute work rests in the office of the secretary of the Board of Agriculture, and the rule of the Board is as follows: "Each agricultural society receiving the bounty of the Commonwealth shall hold within its limits not less than three farmers' institutes each calendar year; and the Board shall render all the assistance in its power to make these institutes interesting and profitable. The secretary of the Board shall provide lectures for farmers' institutes, so far as the appropriation for the object will allow and a wise expenditure of the money warrant, but he shall not be authorized to pay more than one lecturer for each institute. The secretary of each society shall be required to certify to the holding of each institute on blanks furnished by the secretary of the Board." The speakers and subjects are selected by the committee on institutes and public meetings of the Board, with care and discretion, and this list can be depended upon as presenting instructive speakers and specialists on their various subjects. It is the first duty of the agricultural societies to communicate with the secretary of the Board, and all the arrangements with the speaker should be made through his office; next, to see that date, subject and speaker are duly advertised and made known to all the farmers within the territory covered by the society, and that the meeting shall be held in an attractive and comfortable hall. For a society to advertise "no attendance expected," by giving notice of a meeting in an unsuit-

able or out-of-the-way hall or room, is to defeat the good intent of the Board in insisting on the holding of these meetings. The next duty of the societies is to draw out to these institutes a large attendance of practical farmers, with their wives, sons and daughters, to listen to and question the speaker, and carry home the lesson from the ideal standpoint of practical utility.

FARMERS' INSTITUTES.

The institute work of the past year has been in excess of any previous year, only bounded by the amount of money at our disposal. The secretary has been importuned for speakers in all parts of the State where large attendance was assured and great good would doubtless have resulted, but was obliged to refuse because the appropriation would not allow of the expenditure. The following report is presented by Mr. Legate, who is largely in charge of this department:—

During the year 1901, 128 farmers' institutes were held under the auspices of the Board of Agriculture. All of the societies represented on the Board, with the exception of the Massachusetts Society for Promoting Agriculture, held the 3 institutes required by rule of the Board, and 9 of them held 4 or more institutes. There have also been 10 institutes held in sections where there was no incorporated agricultural society to take charge of the meetings, and where the other circumstances seemed to warrant. The average attendance of the institutes of the year, returns having been received from all, shows a most gratifying increase, being 107 this year, against 91 a year ago and 94 for the year 1899. At 6 of the institutes the attendance was 300 or over; at 19 from 200 to 300; at 33, from 100 to 200; at 33, from 50 to 100; and at 36, less than 50. Gratifying as these figures may be, it is to be regretted that there are still some half dozen societies where the interest in these meetings is slight and the attendance perfunctory, and which operate to greatly reduce the average of attendance, and do much to nullify the good work of the Board and the other societies. This office supplied 109 lecturers during the year, at a total cost of \$1,713.82, or \$15.72 per lecture.

FINANCIAL AND PREMIUM RETURNS OF THE AGRICULTURAL SOCIETIES.

The financial returns of the various incorporated agricultural societies, together with an analysis of the premiums and gratuities paid by them, with their membership and institutes for the year 1901, will be found tabulated and printed in this volume.

FORESTS AND FOREST PRESERVATION.

The forests of a country are its grandest charm. A tree is an inspiration to the noblest thought, the purest aspiration. On its beauty the poet has dwelt, and it has inspired the noblest songs. The sage of Concord was a noble example of tree love and communion with nature in her noblest gift of beauty to a lovely world. "The groves were God's first temples." Yes, and when they are defaced, enfeebled or destroyed, something of God's love is lost and a thrill of joy departs from the earth. Travel where you will in our beautiful New England, and the beauty that first enchains the eye and enraptures the heart is the beauty of tree and foliage. Flowers are lovely, and their presence is a ministry full of gentleness, grace and love, but the tree is grander and nobler and higher. The beauty of its foliage is a delight: its graceful form, the artist's dream: and its sturdy strength, defying the tempest's wrath and the winter's blasts, and gaining strength from the very contests with nature in her roughest moods, imparts strength to human endeavor and gives power to buffet and succeed. The old Scotch saying, "Plant a tree, Jamie, and it will grow when ye be sleeping," has in it something more than Scotch thriftiness, — it indicates his sturdy strength and his honest character. We can conceive of no calamity more to be deplored than the defoliating, enfeebling, destructive work of the insect pests, sapping the life of these grand monarchs of hill and dale. To save them is the duty of the present time, when they are menaced by so many dangers, — the gypsy moth, the brown-tail moth, the elm-leaf beetle and the San José scale. Add to these the lumberman's greed and the careless destruction of our forests by fires, and the list is alarming.

The Massachusetts State Board of Agriculture has been instant in season to give warning and to suggest remedies. Its work against the gypsy moth was so well done that there was not a large colony when it was suspended. The danger from the brown-tail moth was clearly seen, and the warning given was endorsed by Governor Wolcott; but the Legislature was wiser, and the result will be its progress across the continent. The elm-leaf beetle is now a menace to our most graceful tree all over New England, and there is no sadder sight than these brown branches struggling against vicious foes. The San José scale is getting too fatal a hold of our fruit product. In the mean time, Massachusetts has no laws of scrutiny or power to enforce inspection, fumigation or safety. All the pests of Europe can come in through the port of Boston. Dr. Howard of the United States Department of Agriculture writes this office that such an invoice of plants and shrubs, consigned to such a party, has arrived at San Francisco or Boston, *via* such a steamer, on such a day, and asks us to see that it is inspected before it is distributed, — and we are powerless. The importer knows the laws, or rather the lack of them, and he will go as far as the law compels, and no farther.

This Board has a noble record that shall never grow dim. It has been first and foremost to point out the danger and urge the remedy, — yes, more, it has given the State the noblest example of self-sacrifice, in its committee working year after year without compensation to protect and preserve the beauty of its landscape, the value of its forests, the benefit of its agriculture. It is well the present secretary should say this, because in its work he had so small a part. It is the simple record of the work of the Board, and the record of this part of the work of this Board will be like the Scotch saying in regard to the planting of the tree, “it will grow when we be sleeping.”

LOSS TO THE STATE FROM INSECT PESTS.

The destruction that wastes at night as well as at noonday in all parts of our State to an incredible extent is that caused by insects, large and small. The extent of defoliation and destruction, the damage to fruits and vegetables, the de-

struction of the beauty of foliage and landscape, the cost of prevention of their ravages and destruction of the pests, is a matter of great financial magnitude. To test the judgment of those best qualified to give a correct estimate of loss caused by these pests, the secretary wrote to Dr. H. T. Fernald, Mr. E. H. Forbush and A. H. Kirkland, M.S., and the replies were so careful and well considered that we shall copy them for the information of this Board. Dr. H. T. Fernald says : —

Years ago a number of experts figuring independently came to the conclusion that for farm, market-garden and orchard crops the loss by the attacks of insects in an average year would represent one-tenth of the value of the crop, or about \$2,600,000 for Massachusetts. Recently, however, prominent entomologists have expressed the opinion that this per cent is too low. Three factors have caused this change: first, the concentration of crops of the same kind into large contiguous acreage; second, the introduction of over one hundred pests from foreign countries, which have been here long enough to make their presence seriously felt; and, third, the great reduction in the number of insectivorous birds.

I believe it will be entirely safe to take 15 per cent of the crop valuation of Massachusetts, and that you will be sufficiently conservative in using that amount as representing part of the damage. I have never seen a cherry tree killed by plant lice, yet I have often seen lice so abundant on cherry trees as to much reduce the crop, which is true of a large proportion of our crops and it is loss of this kind which is covered by the 15 per cent estimate, . . . but how are we to place a money value on the defoliation of an elm tree unless it be repeated year after year until the tree dies? I would be inclined to add, to the 15 per cent estimate already given, \$250,000 for labor, apparatus, poison, etc., used in the fight against insects, and another \$250,000 to cover damage actually done, but which cannot be reduced to figures, making a total yearly damage of \$4,400,000 for Massachusetts.

A. H. Kirkland, M.S., says : —

The best figures available for estimating the loss caused by pests in this State are those of the 1895 census. From the report of this census I have taken figures giving the value of certain crops, notably attacked by insects, and have estimated in each case the probable average reduction in value yearly caused by these pests. The data used are given below. I have tried to make a conserva-

tive estimate in the case of each product, since, to have any value, such an estimate should fall below rather than above the actual amount. Even then the figures afford material for serious reflection on the part of agriculturists.

| PRODUCT. | Value of Product. | Percentage damaged by Insects. | Amount of Damage. |
|---------------------------------------|-------------------|--------------------------------|-------------------|
| Greenhouse products, | \$1,749,070 | 10 | \$174,907 00 |
| Hothouse and hotbed products, | 97,227 | 5 | 4,861 35 |
| Nursery products, | 182,906 | 15 | 27,435 90 |
| Wood products, | 2,780,314 | 20 | 556,062 80 |
| Cereal products, | 1,104,578 | 5 | 55,228 90 |
| Fruits, berries and nuts, | 2,850,585 | 25 | 712,646 25 |
| Hay and fodder crops, | 12,491,090 | 10 | 1,249,109 00 |
| Vegetables, | 6,389,533 | 20 | 1,277,906 60 |
| Tobacco, | 544,968 | 10 | 54,496 80 |
| Property:— | | | |
| Fruit trees, vines, etc., | 7,924,878 | 10 | 792,487 80 |
| Total. | \$36,115,149 | — | \$4,905,142 40 |

Assuming the accuracy of these data, and exclusive of the damage wrought by insects to our woodlands, street trees, parks, etc., we have in round figures \$5,000,000 as the average annual damage from insects to agricultural products and property in this Commonwealth.

Mr. E. H. Forbush, ornithologist to the State Board of Agriculture, says:—

The percentage usually adopted in figuring the damage to farm crops and products from insects is 10 per cent of their value, or, for Massachusetts, according to the latest figures of farm products available, \$2,600,000, and I consider that a safe and conservative estimate of the yearly damage to farm crops. I have no data at hand from which I can estimate the amount of the damage to property or the yearly cost of fighting insect pests in this State, but both items must be considerable, and I would not put the cost of insecticides, time, etc., at less than \$500,000.

THE VALUE OF INSECTIVOROUS BIRDS.

In the mean time, are we doing anything to attract and protect the insectivorous birds, whose value is far beyond our usual computations? What farmer provides houses or nesting-places for many birds that are protecting his crops,—the blue-bird, the phoebe bird or pewee, the swifts, and

the many other birds working for his benefit from early morn to dewy eve, singing and carolling joyously all the day long for his delight? The barn swallow is not neat, he is not welcome in any of our barns, and yet perhaps he is of more importance to the farmer than his best cow, and brings him a better net return at the end of the season. The increased attention now being directed to the value of these birds is most encouraging, and I do not hesitate to again call attention to their importance, and to suggest their money value as an incentive to the practical farmer to encourage them and attract them around his home. Besides, how much joy and delight they give to country life. They are the life of the landscape, the joy of the summer; we look forward to the advent of each species, and as we look on the plumage or catch the note of the harbinger of its kind, it uplifts the heart and increases the joy of the day to us. The birds are our natural allies in the destruction of insects; to encourage them is the truest economy; and this Board is only abreast of the time in calling attention to the importance, yes, the necessity, of more strongly attracting and more carefully protecting our insectivorous birds.

PUBLICATIONS.

The following publications were issued by this office in 1901, and may be obtained on application:—

| | Pages. | Number. | Date of Issue. |
|---|--------|---------|----------------|
| Agriculture of Massachusetts, 1900. . | 689* | 15,000 | May 28. |
| Crop Bulletin No. 1, May, | 40 | 2,600 | June 6. |
| Nature Leaflet No. 8, | 4 | 700 | July 5. |
| Crop Bulletin No. 2, June, | 40 | 2,600 | July 9. |
| Crop Bulletin No. 3, July, | 40 | 2,600 | Aug. 2. |
| Nature Leaflet No. 9, | 4 | 700 | Aug. 30. |
| Crop Bulletin No. 4, August, | 40 | 2,600 | Sept. 6. |
| Nature Leaflet No. 10, | 4 | 700 | Oct. 1. |
| Descriptive catalogue of farms, ninth edition (supply exhausted), | 66 | 3,000 | Oct. 3. |

* Including thirteenth annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 132 pages.

| | Pages. | Number. | Date of Issue. |
|---------------------------------------|--------|---------|----------------|
| Crop Bulletin No. 5, September, . . . | 40 | 2,600 | Oct. 7. |
| Nature Leaflet No. 11, | 4 | 700 | Oct. 30. |
| Crop Bulletin No. 6, October, . . . | 38 | 2,600 | Nov. 4. |
| Farmers' institute pamphlet, . . . | 16 | 800 | Dec. 19. |

There were also issued in pamphlet form "Some lessons from the census," by Dr. Henry S. Pritchett, being an excerpt from the "Agriculture of Massachusetts," 1900; "The influence of the monks in agriculture," by Dr. Henry H. Goodell; and "The culture of the civic virtues," by Rev. Calvin Stebbins; being excerpts from the "Agriculture of Massachusetts," 1901.

CROP BULLETINS OR REPORTS.

The publication of monthly crop bulletins or reports was continued in 1901, and 6 in all were issued (May–October), aggregating some 240 pages of printed matter. The special articles included in these reports were: "Three common orchard scales," by Dr. H. T. Fernald (illustrated); "A lesson in economics: what the agriculture of the twentieth century demands," by Dr. G. M. Twitchell; "Selection and improvement of the dairy herd," by Prof. F. S. Cooley; "Poultry keeping as a principal feature of diversified farming," by John H. Robinson; "Irrigation in humid climates," by Prof. C. S. Phelps; and "Cranberry culture in south-eastern Massachusetts," by John Bursley.

NATURE LEAFLETS.

The publication of nature leaflets has been continued, and 4 leaflets of 4 pages each have been issued, upon the following subjects: "Insects injuring lawns;" "Poison ivy;" "The Datanas;" and "Quince rust."

LEGISLATION.

The legislation of 1901 having reference to the Board of Agriculture or to the agricultural societies was: "An act relative to the raising and preserving of forest trees" (Acts

of 1901, chapter 58) ; “ An act making appropriations for sundry agricultural expenses ” (Acts of 1901, chapter 65) ; “ An act relative to the publication by the State Board of Agriculture of matter to promote the interests of agriculture ” (Acts of 1901, chapter 130) ; “ An act to establish the salary of the second clerk of the secretary of the State Board of Agriculture ” (Acts of 1901, chapter 335) ; and “ An act making an appropriation for the expenses of disposing of property used by the gypsy moth committee of the State Board of Agriculture ” (Acts of 1901, chapter 378).

LEGISLATIVE APPROPRIATIONS : BOARD OF AGRICULTURE.

| OBJECTS FOR WHICH APPROPRIATED. | 1901. | | 1902. |
|--|---------------|-------------|---------------|
| | Appropriated. | Used. | Appropriated. |
| Bounties to societies, | \$19,800 00 | \$19,067 18 | \$19,000 00 |
| Work of Dairy Bureau, | 8,200 00 | 8,200 00 | 8,200 00 |
| Salaries of secretary and clerks, | 6,200 00 | 6,200 00 | 6,200 00 |
| Printing 15,000 copies “Agriculture of Massachusetts,” Pub. Doc. No. 4. | 5,161 29 | 5,161 29 | *5,300 00 |
| Dissemination of useful information in agriculture: lectures, crop reports, farmers’ institutes. | 2,800 00 | 2,799 49 | 2,800 00 |
| Travelling and necessary expenses of the Board. | 1,500 00 | 1,314 97 | 1,500 00 |
| Gypsy moth work, | 1,000 00 | 786 29 | — |
| Incidental and contingent expenses. | 800 00 | 799 90 | 800 00 |
| Abandoned farm work, unexpended balance. | 650 70 | 329 45 | — |
| Travelling and necessary expenses of the secretary. | 500 00 | 375 45 | 500 00 |
| Spikes for marking shade trees, | 200 00 | — | — |
| Aggregates, | \$46,811 99 | \$45,034 02 | \$44,300 00 |

* Estimated.

The Legislature of 1901 made the following appropriations for the Massachusetts Agricultural College: for maintaining an agricultural experiment station, \$10,000; for free scholarships, \$10,000; for labor fund and extra instruction, \$10,000; for theoretical and practical education,

\$10,000; for collecting and analyzing samples of concentrated commercial feed stuffs, \$1,200; for travelling and other necessary expenses of the trustees, \$500; for maintenance fund for the veterinary laboratory, \$1,000; for improvements, repairs and further equipment, \$8,500; and for purchasing band instruments, \$400.

The Legislature of 1901 also appropriated \$50,000 for expenses of exterminating contagious diseases among horses, cattle and other animals.

ABANDONED FARMS.

The work of collecting and distributing information relative to partly abandoned farms and unremunerative lands has been continued, and in September a ninth edition of the catalogue of such farms and lands was issued. The methods adopted were much the same as in former years, but the efforts put forth resulted in getting only 30 new descriptions.

The following tables will illustrate the results accomplished in this line of work since its commencement under chapter 280 of the Acts of 1891:—

Catalogues issued.

| EDITION. | Date of Issue. | Number of Copies. | Total Descriptions published. | Total Farms sold. | Total Farms withdrawn. |
|---------------------|----------------|-------------------|-------------------------------|-------------------|------------------------|
| First, . . . | Nov., 1891, | 3,000 | 330 | — | — |
| Second, . . . | Jan., 1892, | 1,500 | 339 | — | — |
| Third, . . . | Nov., 1892, | 2,000 | 383 | 51 | 22 |
| Fourth, . . . | Nov., 1893, | 2,000 | 400 | 108 | 53 |
| Fifth, . . . | Dec., 1894, | 2,000 | 543 | 150 | 79 |
| Fifth supplement, . | April, 1896, | 1,000 | 560 | 150 | 79 |
| Sixth, . . . | Dec., 1896, | 2,000 | 621 | 242 | 95 |
| Seventh, . . . | Dec., 1897, | 1,500 | 638 | 269 | 103 |
| Eighth, . . . | Sept., 1900, | 2,500 | 710 | 309 | 114 |
| Ninth, . . . | Sept., 1901, | 3,000 | 743 | 334 | 122 |

Financial Statement, 1891-1901.

| | |
|---|-------------------|
| Appropriations of 1891, 1893, 1896 and 1900, | \$5,000 00 |
| Reverted back to State treasury, because unused, | 1,552 20 |
| Amount actually used, | <u>\$3,447 80</u> |
| Printing 20,500 catalogues, 9 editions, 1 supplement, | \$2,142 09 |
| Postage stamps for mailing catalogues and circulars, | 737 00 |
| Special services members of the Board of Agriculture, | 196 30 |
| Special envelopes for mailing catalogues, | 187 82 |
| Printed circulars, | 147 59 |
| Advertising, | 31 50 |
| Sundries, | 5 50 |
| | <u>\$3,447 80</u> |

Summary.

| | |
|--|--------|
| Number of all farms in State, census of 1885, | 45,010 |
| Names of owners or agents given by assessors, | 1,394 |
| Names of owners or agents received from other sources, | 863 |
| Total number of names furnished (duplications eliminated), | 2,257 |
| Number making reply to request for description, | 1,035 |
| Number of descriptions received, | 747 |
| Number stating they did not wish to sell, | 177 |
| Number reporting property already disposed of, | 61 |
| Number stating informant to have been misinformed, | 50 |
| Catalogued farms reported sold, | 334 |
| Catalogued farms withdrawn at request of owners, | 122 |
| Catalogued farms withdrawn from later editions because owners failed to respond to letters of inquiry, | 142 |
| Withdrawn descriptions republished, | 1 |
| Unpublished descriptions on hand, | 4 |

Reported Residence of Purchasers.

| | |
|------------------------------|----------------------------|
| Massachusetts, 188 | Illinois, 3 |
| New York, 19 | Maine, 1 |
| Connecticut, 14 | Indiana, 1 |
| New Hampshire, 6 | Wisconsin, 1 |
| Vermont, 5 | Kansas, 1 |
| Rhode Island, 4 | Pennsylvania, 1 |
| Ohio, 3 | Nova Scotia, 1 |
| New Jersey, 3 | Not reported, 78 |
| Florida, 3 | |

The names would indicate that most of the purchasers were of American parentage.

Intended Use of Farms by Purchasers.

| | | | |
|---|-----|----------------------------------|----|
| For farming purposes, | 123 | For dairying, | 10 |
| For a home, | 28 | For poultry, | 9 |
| For summer residence, | 17 | For sheep raising, | 3 |
| For an investment, | 16 | For cranberry culture, | 1 |
| For the wood and timber, | 15 | For floriculture, | 1 |
| For poultry with some farm- ing, | 10 | For raising hay, | 1 |
| | | No return made, | 98 |

So far as this office has knowledge, purchasers as a rule appear to be well satisfied with their purchases, and the very cordial words with which some of them have endorsed this work show that in their opinion it is meritorious.

Demand for Catalogues and Information.

That there is widespread interest in this work and a desire to know about available farm property in Massachusetts is shown by the many calls for catalogues from all parts of the country.*

Bibliography.

During the past fifteen years newspapers and magazines have printed a large amount of information concerning the depreciation and abandonment of farm property in Massachusetts, and there is in this office a scrap book containing considerable such literature, covering the period from 1888 to the present time: also there are in the office library the publications of other States on this subject. Persons wishing to study into the matter more fully will no doubt find it worth while to examine the following publications:—

“Report of the Commissioner of Agricultural and Manufacturing Interests of the State of Vermont,” 1889–90.

* Between Oct. 8, 1900, and May 7, 1902, this office received by mail alone 3,716 applications for the catalogue. Of these, 921 applications were from our own State; 1,266, from the New England States; 858, from New York State; and 66, from beyond the bounds of our own country. All the States and Territories, excepting Nevada, were represented in these calls. A most noteworthy illustration of the increase in number of calls owing to published information was witnessed between the dates of March 25 and May 7, 1902, largely due, without doubt, to an editorial in one of our monthly magazines, the number of requests by mail being 1,925. On Monday, March 31, the number of requests was 196, while on the two following days the number was 109 and 118 respectively.

“The Quarterly Journal of Economics,” October, 1889.

“Twenty-first Annual Report Massachusetts Bureau of Statistics of Labor,” 1890.

“The Cosmopolitan,” June, 1893.

“Sixth Annual Report of the Commissioner of Industrial Statistics of Rhode Island,” 1893.

“Century Magazine,” April, May and September, 1894, and October, 1901.

“Proceedings of the Farmers’ National Congress,” Boston, 1899.

“Review of Reviews,” September, 1899.

“Ladies’ Home Journal,” May, 1901.

“New England Magazine,” August, 1901.

THE OFFICE LIBRARY.

Attention is called to the report of the librarian, printed in connection with the proceedings of the annual meeting. Recently the library has been the recipient of some 225 volumes, formerly a part of the library of the late Andrew H. Ward, and presented to the Board by his son. Some of these volumes have been placed upon the library shelves; others will be used in exchange, or will be placed where they will be of use in library work.

AGRICULTURAL DIRECTORY.

The usual directory of agricultural organizations in the Commonwealth, with officers for 1902, will be found printed in this volume. It is intended that this directory shall include all organizations of an agricultural nature existing in Massachusetts; and officers of organizations of this nature, not included in the directory, will confer a favor on the office by reporting the existence of their organization, with its officers.

FARMERS’ NATIONAL CONGRESS.

The delegates appointed to attend the meeting of the Farmers’ National Congress, at Sioux Falls, S. D., Oct. 1–4, 1901, were as follows: R. G. F. Candage, Brookline; John G. Avery, Spencer; Henry P. Howland, Spencer; Geo. M. Whitaker, Winthrop; Sallie C. Candage, Brook-

line; Chas. H. Stearns, Brookline; Noah Sagendorf, Spencer; Arthur S. Sagendorf, Spencer; J. W. Stockwell, Sutton; Etham Brooks, West Springfield; W. A. Kilbourn, South Lancaster; Augustus Pratt, North Middleborough; John M. Danforth, Lynnfield Centre; Wm. R. Sessions, Springfield; Q. L. Reed, South Weymouth. The report of the delegates and the address of the president of the Congress will be found printed on pages 336-349 of this volume.

ADVANCE IN AGRICULTURE.

The advance in agriculture in the last few years has been grandly suggestive of its future improvement and ability to meet all demands of the century's growth in population and needs, both domestic and foreign. The storehouse of nature has but half opened its doors to the agriculturist of to-day. He has simply glimpses of the possibilities of the future, under improved methods and with increased knowledge, thanks to the State Board and its institutes, which to a large degree have led in the advance of agriculture, not only in this State but also in other States in this country.

Secretary Wilson is doing a great work, in a single line of his effective department, for agriculture, in demonstrating the capabilities of this country to supply all its needs, on its own soil, from the fruits of the tropics to the productions of our colder climate. We, the farmers of Massachusetts, are doing a good work in demonstrating the utility of growing the fruits of summer at greater profit in the winter by greenhouse culture, within our own borders, thus giving our people these products, fresh, healthful and palatable. This is not an experiment, it is a demonstrated fact; and the enlargement in these lines will be wonderful in the early years of the present century. This is not peculiar to our State or nation, but is part of the forward movement in the world's agriculture. Many of our farmers have specialties in summer culture, and the greenhouse culture comes in to give pleasant and profitable employment in the colder season. Not only lettuce, radishes, tomatoes and cucumbers are now quite extensively cultivated, but the list is being enlarged yearly, and tobacco shading and green-

house culture will soon be a large industry in Massachusetts. For encouragement, one or two illustrations only of its success in Europe. On the Isle of Guernsey Count Kropotkin says: "As I walked through these glass-roofed gardens, which do not know what failure means, and that yield crop after crop through the spring, summer and autumn, I could not but admire the recent conquests of man." Turning to the Island of Jersey, the immense greenhouses of Mr. Bashford are thus described: "From the outside, these huge glass houses and chimneys look like a factory; but when you enter one of these houses, 900 feet long and 16 feet wide, and your eye scans the world of green, embellished by the reddening grapes or tomatoes, you forget the ugliness of the outside view." As to the results, I cannot better characterize than by quoting from a well-known writer on English agriculture, namely, "that the money returns from these 13 acres greatly exceed those of an ordinary English farm of 1,300 acres." This is in line with our own work, and illustrates not only its utility but its grand possibilities.

Going along with this enterprise, our experiment station has sterilized the soil in experiment plots to destroy injurious bacteria, and this method has been tried by some of the market gardeners near Boston with good results. Once sterilized, with care, the soil will be free from injurious germs for a period of years. This discovery does away with the possibility of greenhouse failure in growing fruits and vegetables.

Thus, developing new resources, leading in new methods and demonstrating the practical utility of advanced agriculture, is the work of this Board a benefit to the farmer and to the State.

This was the design of the Massachusetts State Board of Agriculture, and the report of the year just past demonstrates how fully it appreciates its mission and how successful it has been in its work. And, looking back over its work for the improvement of agriculture since it was first established, it needs not words to commend it: in the progress of the last half-century it has been a leading factor, and

the advance in agriculture is its reward. To-day the outlook is bright, and the future of agriculture will improve as we go forward, fully sensible of the duty that rests on this Board, and resolved to give it our best service.

A summary of Massachusetts crop conditions and weather is here appended.

J. W. STOCKWELL,

Secretary of the State Board of Agriculture.

BOSTON, Jan. 7, 1902.

SUMMARY OF CROP CONDITIONS, 1901.

The excessive rains and cool weather of May made the season from one to two weeks late at the close of the month, with farm work still further behind the normal. Pastures and mowings were generally in good condition, and promised well for the future. Fall seeding generally wintered well. The fruit bloom occurred at about the usual time in western sections and a few days later in eastern, and was good for all kinds of fruits except apples, which were light. Insects were doing practically no damage. Spraying was reported as increasing, but not as rapidly as it should. There was, generally speaking, a fair supply of fairly good farm help. Wages averaged about \$18 per month with board and \$1.25 per day without board. Indications were that the acreage of corn and tobacco would be slightly increased, with perhaps a slight decrease in that of potatoes.

Not for many years has there been as little complaint of injury from insects as in June. Corn was very small and backward, but with a good stand and average acreage. Haying was generally beginning, and a good crop was generally expected. The acreage of early potatoes showed a slight decrease, and they were backward because of late planting but looking well. Early market garden crops were about average as to yield and price, though somewhat backward. The quantity and price of dairy products were about as in the previous year, with the supply of dairy cows less than the demand. Pasturage was much benefited by the early rains, and was generally in first-class condition. Strawberry picking had begun, with the prospect of an average crop with good prices. Apples gave indications of a light crop, especially of winter varieties; peaches light; plums and cherries good; pears average.

In July potato bugs and squash bugs appeared to be rather more numerous than usual, but other insects were doing no particular damage. Indian corn came forward very rapidly, and was generally in good condition and growing fast. Silos gain in favor constantly but slowly. Haying was practically completed, with a larger crop than for the last two years, probably a full average crop; quality good, though there was some injury from showers. Returns indicated an increased acreage of forage crops, and they were generally in good condition. Market-garden crops suffered from the hot weather, but later ones promised well; prices rather higher than usual. Very few potatoes were dug at time of making returns, so that no idea could be formed as to yield or prices of the early crop. Apples dropped badly, still further reducing the crop; pears and peaches promised light crops; plums reported as dropping badly; quinces good; grapes promised well. Pasturage came through the dry weather surprisingly well, and was in good condition. Rye was an average crop; oats off in condition; barley promised well as a forage crop.

Indian corn, although still somewhat backward, made a great growth during August, and was generally reported as caring well. Rowen generally promised very well. Early potatoes were a very light crop; later ones made a great showing of vines, but did not set well, and the prospect was for not more than a fair crop at best. The acreage of tobacco was increased and the crop in excellent condition, with cutting practically completed at the end of the month. Apples promised to be one of the lightest crops on record; pears light to fair; peaches light; grapes promised well, as did also cranberries. Pastures were almost everywhere in excellent condition. Oats and barley were below the average for grain and straw. Poultry keeping was generally reported as profitable, but the attention paid to it was not as great as the profit from it warrants.

The warm weather of September ripened Indian corn in excellent condition, and the crop was one of the best ever secured. An unusually good crop of rowen was reported in all sections. Fall feed was also in excellent condition, and

pastures and mowings should start favorably another season. Less than the usual amount of fall seeding had been done, owing to the rains and the backward condition of farm work, but that which was up promised well. Onions were less than an average crop. Potatoes, while somewhat uneven, were considerably below the normal in yield, with many reports of rot. Root crops were generally in excellent condition. Celery was also a good crop. Apples did not promise much over one-fourth crop; pears fair; peaches nearly up to the average, though not a full crop; grapes generally good; cranberries fully an average crop, and mainly secured in good condition.

The last of October root crops were reported to be good average crops. Potatoes were a light crop generally, with a good deal of rot; prices received somewhat higher than for some years. Celery was a good crop. Farm stock almost universally reported as in good condition, many correspondents speaking of it as "very good" or "excellent." Feed in pastures was good throughout the season. Less than the usual amount of fall seeding was done, owing to rains and delayed farm work, but the condition was excellent.

Of the 152 correspondents answering the question as to prices received for crops raised for market, 102 spoke of them as higher and 50 as average. There was the usual diversity of opinion as to the crops that proved most profitable, but 74, a bare majority, placed hay among them. Fifty-eight, — a large number to unite on a second crop, — considered corn to have been among the most profitable crops; 29, potatoes; 9, tobacco; 9, cranberries; 7, onions; 5, asparagus; 5, tomatoes; 4, apples; 4, sweet corn; 4, cabbage; and the remainder named a variety of crops other than those mentioned.

Seventy-nine correspondents, — an unusually large number to unite on any one crop as among the least profitable, — spoke of potatoes as among the least profitable crops; 38, apples; 15, squash; 6, oats; 6, cabbage; 6, corn; 5, fruit; 5, milk; 4, onions; and the remainder named several crops other than those already specified.

Of 151 correspondents answering the question as to the

profits of the season, 86 regarded the season as profitable; 17, as an average one for profit; and 19, as fairly profitable; while 29 thought that it had not been a profitable season.

MASSACHUSETTS WEATHER, 1901. .

[Compiled from data furnished by the New England Weather Service.]

During January there was about the usual amount of cloudiness and sunshine, and the number of stormy days was about the usual average. The average precipitation, 2.02 inches, was about an inch below the normal, but, as it was well distributed throughout the month and over the territory, the deficiency was unimportant. There were no severe or destructive storms. The monthly temperature was about normal and quite even through the month. The snowfall was less than average, but the ground was generally covered through the month.

February was exceptionally pleasant. During 15 days of the month the skies were cloudless, and there was an average of only 6 cloudy days. The precipitation of the month was remarkably light, being but .88 of an inch. The snowfall was light, averaging about 10 inches, but much of it remained on the ground until the close of the month. The temperature formed a conspicuous feature of the month, it being uniformly low, with the monthly average about 3° below the normal. Notwithstanding the low monthly mean, there were no unusual ranges in the maxima and minima of the month.

March was also unusually pleasant, as compared with the average New England March. While the weather was marked by much cloudiness and the monthly precipitation was in excess of the average, there were but 12 stormy days. The precipitation was mostly in the form of rain, and was well distributed. The temperature was near the seasonal average, the slight departure being above the normal. There were no severe or protracted storms.

April was cloudy, wet and cold. The skies were wholly overcast on an average of 19 days and rain fell on 15 days. The precipitation was excessive in all sections, and averaged nearly double the normal amount. To add to the uncom-

fortable conditions of the weather, there was much fog in coast sections and almost continuous easterly winds throughout the State. The mean temperature averaged about 1° below the normal for the month.

The rainfall for May was in excess of the normal, so much so that at the end of the month low lands were still too wet to be worked. There were copious showers on the 1st and 2d, followed by nearly a week of clear weather. Cloudy and rainy weather was nearly continuous from the 9th to the 14th. From that date clear and seasonable weather prevailed until the 18th. From the 18th to the 20th heavy rains occurred in nearly all parts of the State. The highest temperatures of the month were on the 22d and 23d, the mercury reaching to 80° or slightly above, but during the 24th the temperature fell from 20° to 30° . The last week of the month showed cloudy weather with low temperatures. The temperature of the month did not vary greatly from the normal, but it was without the warm days usually experienced in May, making the growth of vegetation slow and backward.

June opened with a week of generally cloudy, cool weather. From the 10th to the 20th the weather was partly cloudy to clear, with almost an entire absence of rain, followed by a season of showers from the 21st to the 25th. The last 4 days of the month were excessively warm. Viewing the month as a whole, the precipitation was largely deficient, being little more than half the normal. The average temperature was several degrees above the normal. There was less than the usual number of thunderstorms, and they were generally less violent than usual. The winds were southerly to westerly. Considered as a whole for the entire State, June was a very pleasant month.

The first three days of July showed the same excessive heat that prevailed in the last days of June. The temperature ruled high throughout the month, and was the most conspicuous feature of the month. From the 14th to the 24th the daily excesses ranged from 6° to 13° above the normal. There was a drop in the temperature on the 25th, and at the close of the month conditions were nearly seasonal.

Taken as a whole, the daily mean temperature was about 2° in excess of the average for July. Showers occurred quite frequently, and were generally well distributed over the State. For the larger portion of the district the monthly precipitation was somewhat in excess of the normal, but in some eastern sections there was some complaint of drought.

The weather of August, as a whole, was not marked by unusual extremes or conditions exceptional to the season. While the temperature averaged slightly above the normal, no very high temperatures occurred, or periods of excessive heat. The nights were seasonably warm. The average temperature for the entire month was about 1° in excess of the normal for August. The cloudiness and sunshine were nearly equal during the first 10 days, followed by a period extending to the 26th with cloudiness somewhat in excess of sunshine. Showers were of frequent occurrence, generally at intervals of three or four days; but the rainfall was in light to moderate amounts until the night of the 24th, when very heavy showers occurred in the greater part of the eastern portion of the State. Though the rainfall of the month was below the normal, the frequency of the showers made it sufficient to keep vegetation in flourishing condition.

The weather of September was uneventful, and characteristic of the season. The first decade was marked by fair weather, mostly with abundant sunshine. Showers on the 11th and 12th were succeeded by several pleasant days. Well-distributed showers fell from the 16th to the 21st, during which period most of the precipitation of the month occurred. There was little complaint of dry weather, and the conditions were most favorable to harvesting and fall seeding. The temperature during the month was almost uniformly high, ranging from 1° to 2° above the normal. The first cool weather occurred on the 20th and 21st, with light to moderate frosts. Frosts also occurred on the 25th, but they were generally too light to greatly damage vegetation. Viewing the month as a whole, the weather was very pleasant.

The weather of October was exceptionally pleasant, with

a preponderance of warm, sunny days. The precipitation was deficient, the monthly amounts being from 1.25 to 1.50 inches below the normal. The rainfall of the month occurred chiefly during the storm of the 14th and 15th. No rain of any consequence fell after this storm. At the close of the month there was urgent need of rain in some sections, and especially in those of the eastern portion of the State. The temperature ranged above the normal for nearly the entire month, and the average excess amounted to about 2° per day. Like September, it was, however, well distributed, and there were no unusual maxima readings. Frosts, moderate to heavy, occurred through the month in about all sections except those of the immediate coast, where the first occurrence was on the morning of the 26th, when it was sufficiently severe to kill vegetation, except in protected places. The mild weather and abundant sunshine were very favorable to grass lands, to pasturage for stock, to fall plowing, seeding, and to all farm operations and out-door work. No severe or destructive wind storms passed over the State during the month. Brisk to high winds occurred on the 19th and 28th, but caused little if any damage. Local disturbances, thunderstorms and hail were reported from some localities, but they were of slight importance and only worthy of passing notice. Viewed as a whole, the weather of October was remarkably fine, and such as is not likely to be often paralleled.

The weather of November was, as a whole, unpleasant, and quite out of the usual for the month. The skies were obscured for more than the average number of days, yet there was a marked deficiency in the precipitation, which occurred on an average of 7 days. The precipitation was chiefly in the form of rain, although snow fell in small amounts at some time during the month in all sections. There were two well-defined storm periods, *i.e.*, the 11th to the 14th and the 24th to the 26th. The latter was a severe storm, which swept the entire coast, attended by heavy precipitation and high winds and gales. There was considerable damage to beach property and to the light class of vessels, but fortunately there was no loss of life. The temperature was

uniformly low, the monthly means being below normal at all stations. According to numerous and reliable records, the month was the coldest of its name for many years.

The weather during December was fairly characteristic of the first winter month. The mean temperature was near the normal for the month. There were, however, some extremes in the record of temperature. From the 11th to the 15th the mercury ranged successively high, the figures being in the 60's during mid-day hours; and this was followed by a severe and protracted cold wave, which prevailed throughout the State from the 16th to the 22d, during which the temperature ranged in the vicinity of zero much of the time. The precipitation of the month was largely in excess of the average of the month. It fell on 11 days, and there were five well-defined storms. High winds and strong gales prevailed along the coast during the 15th, but, so far as reported, without serious damage to shipping. Snow fell in moderate amounts on several dates, and sleighing was good much of the time, especially in interior sections. Generally speaking, the weather of the month was representative of the season.

METEOROLOGICAL OBSERVATORY OF THE HATCH EXPERIMENT STATION (MASSACHUSETTS AGRICULTURAL COLLEGE), AMHERST.

ANNUAL SUMMARY FOR 1901.

Pressure (in Inches).

Maximum reduced to freezing, 30.36, January 3, 10 A.M., January 20, 9 A.M.
 Minimum reduced to freezing, 28.69, January 28, 1 A.M.
 Maximum reduced to freezing and sea level, 30.69, January 3, 10 A.M., January 20, 9 A.M.
 Minimum reduced to freezing and sea level, 29.01, January 28, 1 A.M.
 Mean reduced to freezing and sea level, 29.955.
 Annual range, 1.68.

*Air Temperature (in Degrees F.).**

Highest, 100.5, July 2, 1.30 P.M.
 Lowest, — 10.5, December 7, 7.30 A.M.
 Mean, 46.9.
 Mean of means of max. and min., 46.8.
 Mean sensible (wet bulb), 43.4.
 Annual range, 111.0.
 Highest mean daily, 83.9, July 1.
 Lowest mean daily, 2.5, January 19.
 Mean maximum, 57.1.
 Mean minimum, 36.6.
 Mean daily range, 20.5.
 Greatest daily range, 50.0, April 29.
 Least daily range, 3.5, March 12.

Humidity.

Mean dew point, 37.6.
 Mean force of vapor, .421.
 Mean relative humidity, 71.0.

Wind.—Prevailing Direction West. Summary (Per Cent).

North-west, 11.
 North, 10.
 South, 15.
 West, 12.
 Other directions, 52.
 Total movement, 50,353 miles.
 Greatest daily movement, 520 miles, December 15.

Least daily movement, 3 miles, December 19.
 Mean daily movement, 138.0 miles.
 Mean hourly velocity, 5.75 miles.
 Maximum pressure, per square foot, 24.0 pounds = 69 miles per hour, September 11, 5 P.M., S.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 49.72.
 Number of days on which .01 or more rain or melted snow fell, 135.
 Snow total, in inches, 52.3.

Weather.

Mean cloudiness observed, 60 per cent.
 Total cloudiness recorded by sun thermometer, 2,590 hours = 58 per cent.
 Number of clear days, 81.
 Number of fair days, 105.
 Number of cloudy days, 179.

Bright Sunshine.

Number of hours recorded, 1,866 = 42 per cent.

Dates of Frosts.

Last, May 6.
 First, September 26.

Dates of Snow.

Last, April 3.
 First, November 11.
 Total days of sleighing, 46.

Gales of 50 or More Miles per Hour.

April 15, 52 miles, N.E.; July 2, 54 miles, W.; September 11, 69 miles, S.; November 24, 59 miles, E.; December 14, 50 miles, S.W.; December 15, 54 miles, S.W.; December 31, 51 miles, N.W.

* Temperature in ground shelter.

MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE,

1901.

MEETINGS OF THE EXECUTIVE COMMITTEE, ACTING FOR THE BOARD.

Boston, Jan. 25, 1901.

The request of the Middlesex South Agricultural Society for the approval by the Board of Agriculture of its vote, passed at a special meeting of the society, Jan. 7, 1901, "That the treasurer be authorized to make, under the corporate seal of the society, and to acknowledge and deliver in the name and behalf of the society to said Addison M. Thayer, a mortgage deed of such real estate, in the usual form, and with the customary power of sale; and also to make a note to said Thayer in the name and behalf of the society for the sum of four thousand dollars, the above-named amount to be secured by the mortgage," being in order, the matter was considered.

The president and treasurer of the society appeared, and gave the reasons for the request and for the actions of the society. There was presented a certified copy of the records of the meeting, showing that it was legally called and that the vote was passed by the necessary two-thirds; also copies of the advertisement of the hearing by the Board of Agriculture.

No person appearing in opposition to the request, it was

Voted, To approve for the Board of Agriculture the above-quoted vote of the Middlesex South Agricultural Society, in accordance with the provisions of chapter 274, Acts of 1890.

Voted, That the secretary send notice to delinquent societies, requiring them to report forthwith.

The matter of the dates for the fair of the Bristol County Agricultural Society being under consideration, it was

Voted, That in view of the fact that neighboring societies hold their fairs on consecutive days before or after, and these

dates were made for the best good of these several societies, the Executive Committee deems it inexpedient to change the dates of the Bristol County Agricultural Society.

BOSTON, May 3, 1901.

The credential of John S. Anderson of Shelburne, elected by the Franklin County Agricultural Society to the Board of Agriculture, was presented and accepted.

The Middlesex North Agricultural Society having filed its transactions for 1900, the delinquency was excused.

The request of the Amesbury and Salisbury Agricultural and Horticultural Society for the approval by the Board of Agriculture of its vote, passed at a special meeting of the society, on April 20, 1901, "To mortgage the property of the society to Mrs. Kimball for seventeen hundred dollars," being in order, the matter was considered.

The president and delegate of the society were present, and stated the reasons for the mortgage. There was presented a certified copy of the records of the meeting, showing that it was legally called and that the vote to mortgage was unanimous; also a postal card notice of the call for the meeting, and also copies of the advertisement of the hearing by the Board of Agriculture.

No person appearing in opposition to the request, it was

Voted, To approve for the Board of Agriculture the above-quoted vote of the Amesbury and Salisbury Agricultural and Horticultural Society, in accordance with the provisions of chapter 274, Acts of 1890.

SWANSEA, Aug. 23, 1901.

Voted, To grant the request of the Manufacturers' Agricultural Society in North Attleborough to hold its 1901 fair on October 8, 9 and 10, instead of on the dates granted by the Board at the annual meeting.

The Blackstone Valley Agricultural Society having filed its transactions for 1900, the delinquency was excused.

SUMMER MEETING
OF THE
BOARD OF AGRICULTURE,
AT
SWANSEA.

AUGUST 23, 1901.

SUMMER MEETING OF THE BOARD,
AT SWANSEA.

The summer meeting of the Board of Agriculture was held at South Swansea, at the residence of Mr. E. M. Thurston, member of the Board for the Bristol County Agricultural Society, Friday, Aug. 23, 1901.

At 11 o'clock A.M. the gathering was called to order by Mr. Augustus Pratt, second vice-president of the Board, who introduced as the first speaker Dr. H. H. Goodell, president of the Massachusetts Agricultural College; subject, "The influence of the monks in agriculture." Dr. Goodell was followed by Rev. Calvin Stebbins of Framingham, on "The culture of the civic virtues." These addresses are printed as a part of the proceedings of this meeting and are especially noteworthy in their timeliness, research and scope.

After the addresses dinner was served, followed by speeches by Congressman Wm. S. Greene and J. Milton Reed of Fall River; Gen. Francis H. Appleton of the Board of Agriculture; Capt. R. G. F. Candage, president of the Farmers' National Congress; and Mr. J. P. Brown, secretary of the Indiana State Forestry Association.

THE INFLUENCE OF THE MONKS IN AGRICULTURE.

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I have chosen for my subject this afternoon “The influence of the monks in agriculture,” — the influence of men who, taking their lives in their hands, flung themselves into the wild forests and abandoned wastes of Europe and the remoter East, and wrought a work which, as far as we can judge, could have been wrought in no other way; “for it was done by men who gave up all that makes life dear and worth the living, for the sake of being good themselves and making others good.” They were the pioneers of a physical, no less than a moral, civilization. Never were instruments less conscious of the high ends they were serving, and never were high ends more rapidly or more effectually achieved. Apostles of the Lord, they pushed out into the midst of tribes only wilder and more savage than the country they inhabited, determined to bring them within the fold. But the instinct of self-preservation compelled them first to turn aside to reclaim and till the soil, to construct houses, to provide themselves with the necessities of life, to practise the arts and sciences in order that they might live. And so, ministering to their bodily wants, they ended by forcing upon their barbaric neighbors first civilization and then Christianity. Kingsley, in his spirited way, tells us “They accepted the lowest and commonest facts of the peasant’s life. They outdid him in helplessness and loneliness, in hunger and dirt and slavery, and then said, ‘Among all these I can yet be a man of God, wise, virtuous, free and noble in the sight of God, though not in the sight of Caesar’s courts and knights.’”

The time at which this great work began was almost coincident with the Christian era, and lasted through what we are pleased to call the dark or mediæval ages, but which, when we come to examine, we find to our surprise filled with light, with charities of the noblest kind and enduring monuments of Christian grace.

With the fall of the Roman empire and the influx of the great waves of barbaric tribes that swept over Europe, civilization was stamped out and Christianity ceased to exist. The cleared lands and cultivated fields reverted to forest and moor, cities and towns lay in ruins, and the citizen was reduced to the condition of the beggar and the slave. The despairing cry of St. Jerome from his peaceful hermitage at Bethlehem fell vainly on the ears of a hopeless world : “ For twenty years Roman blood has been flowing every day between Constantinople and the Julian Alps. Seythia, Thrace, Macedonia, Dacia, Thessalonica and Epirus all belong to the barbarians, who ravage, rend and destroy everything before them. How many noble matrons and maids have been the toys of their lust : how many bishops in chains, priests butchered, churches destroyed, altars turned into stables, relics profaned ! Sorrow, mourning and death are everywhere. The Roman world is crumbling into ruins.” And what St. Jerome so vividly describes of the Eastern world was equally true of the West. France, Germany, Spain, Italy and England had all fallen a prey to the never-ending swarms that poured across the barrier rivers of the Rhine and Danube.

But out of the midst of this universal chaos and desolation now burst forth an army of Christian soldiers. Some, taking upon themselves vows of solitude and self-renunciation, penetrated the wilderness to live as ascetics, — a life of prayer and holy calm, withdrawn from the turmoil and wretchedness of the world ; others, seeking out the most inaccessible and unfrequented spots, erected their buildings, and, gathering about them their disciples, entered upon the true monastic life ; while yet others again, as missionaries, advanced boldly into the enemy’s dominions, to conquer back for the church the territory it had lost, and to gather into its folds these new peoples and new tribes whose in-

vasion had destroyed the Roman world. And it was their glory that in a few short centuries they succeeded. But whether as hermit or missionary or monk they abandoned their homes and embraced this painful life, the result was in every case the same, — agriculture and the arts first, and civilization and Christianity last. It could not be otherwise; the necessities of the case compelled it. Solitaries who shrunk from all contact with humanity were becoming the unconscious instruments for the civilization and conversion of savages and heathen. They penetrated valleys choked with rocks, brambles and brushwood, the overgrowth of generations interlaced into a barrier not to be penetrated by anything weaker than their untiring energy. They are the sternest of ascetics and most isolated of hermits. But their rest is broken by penitents who come to ask their blessing and who implore permission to live under their authority. The solitary cell of the hermit becomes the nucleus of a society, — the society a centre of many congregations radiating from it. The little plot of herbs becomes a garden; the garden stretches out into fields of waving grain; the hills are clothed with vines, the valleys bowered in fruit trees. Opening their doors to all, receiving under their shelter and protection the oppressed, the weak, the criminal, the slave, the sin-sick soul weary of this life and despairing of another, the mourner and the comfortless, it frequently happened that the inmates of these cloisters, those attached to one community and under one jurisdiction, numbered thousands. Lecky tells us that in one city on the Nile there were twenty thousand monks and ten thousand nuns, — the religious far outnumbering the other classes of society. In England and Ireland these monastic communities assumed a peculiar form. Kings, followed by their entire tribe, presented themselves at the baptismal font and came under religious rule; and frequently these kings were chosen abbots, and as in their worldly life they had ruled their subjects, so in their spiritual life they continued to be their recognized head and leader. To such an extent was this carried, that in England in the course of a single century there resulted an alarming diminution of the military re-

sources of the country ; and there is still extant a letter of the great churchman, the venerable Bede, in which, imploring the kings and bishops to put a stop to the grants of land for monastic purposes, because frequently misused, he says : “ Many Northumbrians put aside their arms, cut off their hair and hasten to enroll themselves in the monastic ranks, instead of exercising themselves in their military duties. The future alone will tell what good will result from this.” Perhaps some of you will recollect a more modern instance in the law of Peter the Great, forbidding any state officer, citizen in business or workman from entering the cloisters, affirming that he would not consecrate to idleness subjects that might be useful.

To support now these throngs of people that assumed the cowl, it was necessary for the monks to devote themselves to agriculture and horticulture, and this they did in a most successful manner. “ It is impossible to forget,” says the great historian of the monks, “ it is impossible to forget the use they made of so many vast districts (holding as they did one-fifth of all the land in England), uncultivated and uninhabited, covered with forests or surrounded by marshes. For such, it must not be forgotten, was the true nature of the vast estates given to the monks, and which had thus the double advantage of offering to communities the most inaccessible retreats that could be found, and of imposing the least possible sacrifice upon the munificence of the giver.” Kings and barons vied with each other in their eagerness to save their souls from hell and pave the way to heaven by giving to these poor monks land the most desolate and unfertile, land no other human beings would inhabit, land covered with sand or rock or buried in water for the greater part of the year. How man or woman born could live in such unwholesome and unproductive spots and thrive seems absolutely miraculous, but these patient toilers of the church surmounted all the difficulties which stared them in the face of beginning the cultivation of a new country.* The forests were cleared, the marshes made wholesome or dried up, the soil irrigated or drained, according to the requirements

* Montalembert, “ Monks of the West.”

of each locality, while bridges, roads, dykes, havens and light-houses were erected wherever their possessions or influence extended. The half at least of broad Northumberland, covering an area of about two thousand square miles, was lost in sandy plains and barren heaths; the half at least of East Anglia and a considerable part of Mercia were covered with marshes, difficult of access. Yet in both these regions the monks substituted for these uninhabitable deserts fat pasturage and abundant harvests. The latter district, the present name of which (the Fens) alone recalls the marshy and unwholesome nature of the soil, became the principal theatre of the triumphs of agricultural industry, performed by the monks. Medehamstead (now Peterborough), Ely, Croyland, Thorney (now Southampton), Ramsay, were the first battle-fields of these conquerors of nature, these monks who made of themselves plowmen, breeders and keepers of stock, and who were the true fathers of English agriculture, which, thanks to their traditions and example, has become the first agriculture in the world.

Perhaps in no better way can I more graphically bring before you the immense work of the monks than by giving you a picture of the fen district of Southampton before Thorney Abbey was founded, and then reading you the description of this abbey by the great bishop of Tyre, William of Malmesbury. Southampton is a peninsula making down between the mouths of the Itchen and the Test or Anton into the tide-swept channel that separates it from the Isle of Wight. It was nothing but a vast morass.* The fens in the seventh century were probably like the forests at the mouth of the Mississippi or the swamp shores of the Carolinas. It was a labyrinth of black, wandering streams; broad lagoons, morasses submerged every spring-tide; vast beds of reed and sedge and fern; vast copses of willow, alder and gray poplar, rooted in the floating peat, which was swallowing up slowly, all-devouring, yet all-preserving, the forests of fir and oak, ash and poplar, hazel and yew, which had once grown in that low, rank soil. Trees torn down by flood and storm floated and lodged in rafts, damming the

* Kingsley, "Hermits."

waters back upon the land. Streams bewildered in the forests changed their channels, mingling silt and sand with the black soil of the peat. Nature left to herself ran into wild riot and chaos more and more, till the whole fen became one dismal swamp. Four or five centuries later William of Malmesbury visits the place and leaves us this charming picture of the change :* “It is a counterfeit of Paradise, where the gentleness and purity of heaven appear already to be reflected. In the midst of the fens rise groves of trees which seem to touch the stars with their tall and slender tops ; the charmed eye wanders over a sea of verdant herbage, the foot which treads the wide meadows meets with no obstacle in its path. Not an inch of land as far as the eye can reach lies uncultivated. Here the soil is hidden by fruit trees ; there by vines stretched upon the ground or trailed on trellises. Nature and art rival each other, the one supplying all that the other forgets to produce. O deep and pleasant solitude ! Thou hast been given by God to the monks, so that their mortal life may daily bring them nearer to heaven.”

Everywhere we see the monks instructing the population in the most profitable methods and industries, naturalizing under a vigorous sky the most useful vegetables and the most productive grains, importing continually into the countries they colonized animals of better breed, or plants new and unknown there before ; here introducing the rearing of cattle and horses, there bees or fruit ; in another place the brewing of beer with hops ; in Sweden, the corn trade ; in Burgundy, artificial pisciculture ; in Ireland, salmon fisheries ; about Parma, cheese making, and finally occupying themselves with the culture of the vine and planting the best vineyards of Burgundy, the Rhine, Auvergne and England, for the monks of Croyland introduced it even into the fens of Ely and in other countries where the vine has now disappeared. They were the first to turn their attention to improving the breeds of cattle, declaring that the promiscuous union of nobody’s son with everybody’s daughter resulted in half-starved oxen “euyll for the stone and euyll for diges-

* “Chronicle of William of Malmesbury.”

tyon, fitter to be used outside as a waterprooffe than inside." They taught the necessity of letting the land be fallow for a time after several years of continuous cropping; they practised rotation of crops, using clover as the last in the series; they improved the different varieties of fruits and learned the art of grafting, budding and layering; they taught by precept and example the value of drainage and irrigation. In short, in everything making for progressive agriculture we find them blazing the way, and when the monasteries were suppressed by Henry VIII. a death-blow was struck for a time at scientific agriculture and horticulture.

And what they did for England was paralleled by their work upon the continent. Need we point to any other instance than that of Vitruvius peopling the sand banks of Flanders or Belgium with religious who, by their unwearied industry, reclaimed those arid wastes and turned those burning sands into one vast garden? Need we speak of the country separating Belgium from Holland, and how it was cleared by the monks who taught its wild inhabitants agriculture as well as Christianity? In a manuscript bearing date of 1420 a monk proposed the artificial propagation of trout. It was the monks of Fulda who started the celebrated vineyards of Johannisberg, the Cistercian monks that of Clos Vougeot. The Benedictines brought vines from Beaune to plant on the banks of the Allier. The monks of Mozat set out walnut trees, still so abundant in Lower Auvergne. They first cared for the preservation of forests as affecting climate and fertility. They stored up the waters of springs and distributed them in drought, and it was the monks of the abbeys of St. Laurent and St. Martin who first brought together and conducted to Paris the waters of springs wasting themselves on the meadows of St. Gervais and Belleville: and in Lombardy it was the followers of St. Bernard who taught the peasants the art of irrigation, and made that country the most fertile and the richest in Europe.

We approach now another and higher phase of monastic life. In its earlier days we find the monks engaging in the practice of agriculture from the necessities arising out of the conditions in which they were placed. They had plowed,

they had sowed, they had reaped in order to preserve their lives. But now agriculture becomes a part of their religion, and the great St. Benedict enjoins upon his disciples three objects for filling up their time: Agriculture, literary pursuits and copying manuscripts.* He comes before the world saying: "No person is ever more usefully employed than when working with his hands or following the plow, providing for the use of man. . . . He bent himself to the task of teaching the rich and the proud, the poor and the lazy the alphabet of prosperity and happiness." Agriculture was sunk to a low ebb. Marshes covered once fertile fields, and the men who should have tilled the land spurned the plow as degrading. The monks left their cells and their prayers to dig ditches and plow fields. The effort was magical. Men once more turned back to a noble but despised industry, and peace and plenty supplanted war and poverty. So well recognized were the blessings they brought that an old German proverb among the peasants runs, "It is good to live under the crozier." They ennobled manual labor, which, in a degenerate Roman world, had been performed exclusively by slaves, and among barbarians by women. For the monks, it is no exaggeration to say the cultivation of the soil was like an immense alms spread over a whole country. The abbots and superiors set the example, and stripping off their sacerdotal robes toiled as common laborers. Like the good parson whom Chaucer portrays in the Prologue to the "Canterbury Tales":—

This noble ensample unto his scheep he gaf
That first he wroughte and after that he taughte.

When a papal messenger came in haste to consult the Abbot Equitius on important matters of the church, he was not to be found anywhere, but was finally discovered in the valley cutting hay. Under such guidance and such example the monks upheld and taught everywhere the dignity of labor, first, by consecrating to agriculture the energy and intelligent activity of freemen, often of high birth and

* Weishardt, "History of Monasticism."

clothed with the double authority of the priesthood and of hereditary nobility, and second, by associating under the Benedictine habit sons of kings, princes and nobles with the rudest labors of peasants and serfs.

There is still another phase of this monastic life. We have seen that the one universal and regular duty imposed was the necessity of being constantly employed. It was work for the sake of work. The object sought was not so much what would be produced by the labor as to keep the body and mind so constantly employed that temptations could find no access and sin would therefore be escaped. Consequently it was a matter of comparative indifference what the work was. The harder and more painful and unattractive to men in general it might be so much the better for the monk. If sufficiently difficult, the element of penance was added, and it became a still more effectual means of grace. In this way the monks did a great amount of extremely useful work which no one else would have undertaken. Especially is this true of the clearing and reclaiming of land. A swamp was of no value. It was a source of pestilence. But it was just the place for a monastery because it made life especially hard, and so the monks carried in earth and stone, and made a foundation, and built their convent, and then set to work to dyke and drain and fill up the swamp, till they had turned it into fertile plow-land and the pestilence had ceased.

The connection of the monasteries with the great centres of population to-day is an interesting one.* The requirements of the monks and the instruction they were enabled to impart soon led to the establishment in their immediate neighborhood of the first settlement of artificers and retail dealers, while the excess of their crops, their flocks and their herds gave rise to the first markets, which were as a rule held before the gate of the abbey church, or within the church-yard, among the tombs. Thus hamlets and towns were formed which became the centres of trade and general intercourse, and thus originated the market tolls and the jurisdiction of these spiritual lords. Out of these hamlets

* Gibbins, "Industrial History of England."

clustered around the monasteries arose in England Southampton, Peterborough, Bath, Colchester, Oxford, Cambridge, Ely and many others.

In the earlier days the monks had always taken the lead in farming, and if improvements were introduced it was sure to be the monks who were the pioneers. How useful the monasteries had been and what an important factor they were is perhaps best seen from the effect their dissolution had upon the laboring classes. Henry VIII. suppressed six hundred and forty-four monasteries, ninety colleges, two thousand three hundred and seventy-four free chapels and one hundred and ten hospitals. These held one-fifth of all the land in the kingdom and one-third the national wealth. At the same time nearly one hundred thousand male persons were thrown out of employment. "It is possible," says Symes in Traill's "Social England," "that the relieving of a large number of persons from the obligations of celibacy partly accounts for the great increase of the population which undoubtedly took place in Henry's reign. Moreover, experience proves that people reduced to poverty and desperation often show extraordinary recklessness in bringing people into the world." However that may be we find the population from the reign of Henry VII. to the death of Henry VIII. increasing from two and one-half millions to four millions. But this change in population without corresponding distribution of wealth, this transference of one-third the national wealth, was attended by another still more disastrous effect, and that was "the change in the character of the demand for labor, which reduced to the ranks of the unskilled those whose skill was no longer in demand." The land taken up by the king was bestowed upon his nobles and favorites, and these, desirous of securing immediate and larger profits, enclosed immense areas and turned to the breeding and pasturing of sheep. It was the substitution of pasture for tillage, of sheep for corn, of commercialism for a simple, self-sufficing industry, of individual gain for the old agrarian partnership in which the lords or abbots, the parsons, yeomen, farmers, copyholders and laborers were associated for the supply of the

wants of the villagers.* A perfect frenzy for raising sheep took possession of the agricultural community. No pains were spared to increase the extent of pasturage. Small tenants were evicted, laborers' cottages were pulled down, the lords' demesnes turned into pasturage, and wastes and commons which had before been open to all were now enclosed for the same purpose. Every one was now convinced that "the foot of the sheep would turn sand into gold," and hastened to substitute grazing for tillage. But while there was this sudden and wholesale transference of the arable land to pasturage, as sudden and violent a change in the character of labor was required. The dog and the shepherd took the place of the plowmen and their teams, and thus diminished the demand for labor at the very moment when the supply was increased. Very serious results followed. The poorer tenants were ruined and an immense number of persons were thrown out of employment, to become beggars and thieves. It was, says Gibbins in the "Industrial History of England," the beginning of English pauperism. That this was no trifling change in the social condition of the people the following quotations will prove: "The Statute-book for 1489 tells us that the Isle of Wight is lately become decayed of people, by reason of many towns and villages having been beaten down and is desolate and not inhabited, but occupied with beasts and cattle; throughout England, too, we are assured that idleness daily doth increase; for where in some towns two hundred were occupied and lived of their lawful labor, now there are occupied only two or three herdsmen." Starkey, the royal chaplain in the next reign, only puts this more epigrammatically when he says: "Where hath been many houses and churches to the honor of God, now you shall find nothing but sheepcotes and stables to the ruin of men, and that not in one place or two, but generally throughout this realm." Finally, if any further evidence is wanted to show that great hardships were being entailed upon the peasantry, there are the indignant words of Sir Thomas More, in which he bids us sympathize with "the husbandmen thrust out of

* Traill, "Social England."

their own, or else by covin and fraud, or by violent oppression put beside by it, or by wrongs and injuries so wearied that they sell all," and goes on to denounce the noblemen and gentlemen, yea, and certain abbots that lease no grounds for tillage; that enclose all into pasture, and throw down houses; that pluck down towns and leave nothing standing, but only the church to be made a sheephouse.

In a word, then, the monks were the scientific farmers of the day. They had access to all the knowledge of the ancients, and the constant intercourse with their brethren in other countries kept them acquainted with methods of agriculture and products other than their own, and when their great religious houses were suppressed, agriculture, of which they had been the pioneers, came for a time to a standstill.

There were four great periods in which these disciples of civilization were steadily pushing their way into the darkness of an unregenerate world; and in like manner there were four great periods in which, in one way or another, vast estates were added to their jurisdiction and came under their kindly influence. The first, covering the first five centuries of the Christian era, may not inappropriately be termed that of the Apostles and early fathers. And I cannot help quoting here the vivid words of Hillis, descriptive of that era: "With matchless enthusiasm these young knights of the new chivalry leaped into the arena. Beginning at Jerusalem they scattered in every direction, marching forth like columns of light. When twenty years had passed Matthew was two thousand miles to the south-west. At the same time Jude was two thousand miles to the north-east. James the Less journeyed east into Judea. Paul journeyed to the west. When two-score years had passed all the disciples save one had achieved a violent death and blazed out paths in the dark, tangled forests. And when the torch fell from the hands of these heroes, their disciples snatched up the light and rushed on to new victories. Now that long time has passed, history has summarized the influence of these missionaries. If we ask who destroyed the great social evils of Rome, Lecky answers, 'The Christian missionaries.' Asked when the rude tribes of the northern

forests began to be nations, Hallam answers, 'When Boniface crossed the Alps on his Christian mission.' Asked for the beginning of England's greatness, Green tells us the story of the two Christian teachers who one winter's night entered the rude banquet hall of King Ethelbert."

About the middle of this period commenced the hermit or ascetic life in the far East. Paul, Anthony, Pacomius and others, gathering together the thousands of disciples that had followed them, peopled the arid wastes and rocky valleys of the Thebaid with their nuns and monks.

Next follows the missionary period, in which these devoted soldiers of the cross, pushing their adventurous way into every part of Europe, reconquered for the church the territory it had lost, and, planting their monasteries in the wildest and most unfrequented spots, became the heralds of civilization and Christianity. In this period and in the last the monasteries were largely enriched by the gifts of the faithful, — in most cases the donors begging the intercession of the monks in their behalf. Thus St. Eloysius in his charter to the monks of Solignac writes: "I, your suppliant, in the sight of the mass of my sins, and in hopes of being delivered from them by God, give to you a little thing for a great, earth in exchange for heaven, that which passes away for that which is eternal." So Peter, the Lord of Maule, says: "The prudent ant as she sees winter approach makes the more haste to bring in her stores, so as to assure herself of abundant food during the cold weather. I, Peter, profiting by this lesson, and desirous, though a sinner and unworthy, to provide for my future destiny, I have desired that the bees of God may come to gather honey in my orchards, so that when their fair hives shall be full of rich combs of this honey, they may be able, while giving thanks to their Creator, to remember him by whom this hive was given."

Eager, ardent and impetuous, these anchorites seemed to take the continent by storm.* Amid the gloom of the Thuringian forests, among the wild precipices and caves of the mountains of the Hartz, on the wild, desolate shores of

* McLear, "Apostles of Mediæval Europe."

the German and Baltic seas, amid the glaciers and fiords of the Scandinavian peninsula, on the banks of the Ysill and the Weser, from the Weser to the Elbe and thence to the ocean, these devoted missionaries toiled and taught and laid down their lives.

The third great period came at the close of the tenth century and may be termed the age of expectancy and dread. All things seemed coming to an end, and the year one thousand was fixed upon as the day when the heavens should melt with fervent heat and the hills be rolled together and crushed. We can scarcely form any idea of the feverish state of mind of society. As the days sped on and the time approached for the universal dissolution of nature the panic was at its height. Property was disposed of for a merely nominal sum, or willed to the church, the bequest commencing in these words, "In expectation of the approaching end of the world." The monasteries and abbeys received vast acquisitions of property and were thronged with sinners seeking a refuge within the pale of the church. Kings laid down their sceptres and lands were left untilled. Famine and pestilence added their horrors to the universal despair. Human flesh was openly consumed and the graves of the dead were rifled to furnish sustenance to the living. Night after night, at any unusual disturbance of the elements, whole families, nay, the inhabitants of whole villages, left their beds and watched the livelong night, shivering, upon the bleak hillsides, or in the gateways of the churches. The fear of death was upon all, — God and the judgment bar an ever-present reality. The terrors of an unknown world stared them in the face. Hell opened wide the portals of its gates, and the cries and torments of the damned seemed to rise up, upon the excited ear. "Help, Lord, for we perish! Save, Lord, from thy wrath!" was the wail of a despairing world. Can we wonder that in such circumstances as these, surrounded by such an atmosphere as this the church should gain a predominating influence, and that as a medium between God and man it should stretch forth its arm and be recognized as all-powerful and efficient? And when the last night of suspense was over and the sun had

risen again, and men breathed freer and felt that the crisis was past, would they not have a feeling of gratitude that expressed itself in gifts to those whom they had learned to look upon as intercessors?

The fourth and last period was that of the Crusades, when all Europe, stirred by one single impulse, leaps into vigorous life, and hurries, men, women and children, to the rescue of the Holy Land. Of the universality of this movement, the last impulse of the migratory instinct among these tribes so lately settled down, William of Malmesbury, afterwards bishop of Tyre, has left us a striking account in his chronicle. Having said that after the great council of Clermont every one retired to his home, he continues thus: "Immediately the fame of this great event being spread through the universe, penetrates the minds of Christians with its mild breath, and wherever it blew there was no nation, however distant or obscure it might be, that did not send some of its people. This zeal not only animated the provinces bordering on the Mediterranean, but all who had ever heard the name of a Christian in the most remote isles and among barbarous nations. Then the Welshman abandoned his forests and neglected his hunting; the Scotchman deserted his fleas, with which he is so familiar; the Dane ceased to swallow his intoxicating draughts and the Norican turned his back upon his raw fish. The fields were left by the cultivators and the houses by the inhabitants; all the cities were deserted. People were restrained neither by ties of blood nor the love of country; they saw nothing but God. All that was in the granaries or destined for food was left under the guardianship of the greedy agriculturist. The voyage to Jerusalem was the only thing hoped for or thought of. Joy animated the hearts of those who set out; grief dwelt in the hearts of those who remained. Why do I say of those who remained? You might have seen the husband setting forth with his wife, with all his family; yea, you would have laughed to see all the penates put in motion and loaded upon carts. The road was too narrow for the passengers, more room was wanted for the travellers, so great and numerous was the crowd."

From this great movement, which lasted two hundred years, the church gained an enormous increase of power and territory. The secular princes ruined themselves for the cause of Jesus Christ, whilst the princes of the church took advantage of the fervor of the Christians to enrich themselves. It bought up for a mere song an immense extent of property, which the owners disposed of to raise the funds requisite to equip them for this long journey, and thus laid the foundation for those extensive church endowments which in the time of Luther and the French Revolution excited so bitter a controversy.

Summing up then the influence of the monks, we can outline it thus: The rule of St. Benedict presented agriculture as an occupation useful and worthy of a truly religious person whose life was to be spent between manual labor and spiritual contemplation.* He taught that the brothers ought not to feel themselves humiliated if poverty compelled them to gather with their own hands the products of the soil. First, then, they themselves cultivated the ground, and this has been continued even until our own time in certain orders. The monks of Cîteaux were particularly distinguished in this respect, for in their earlier days it was not permitted them to possess any revenues. When a new monastery was founded there was ordinarily bestowed upon it land not yet broken or land which, having been devastated by the incursions of the enemy, had become useless to its owner. Sometimes it was covered with forests or with water, or it was a sterile valley surrounded by lofty mountains, or a country in which there was no arable land and it was necessary for the monastery to purchase earth in the neighborhood and bring it in. The monks cleared with their own hands the forests and erected peaceful habitations for man in the spots where formerly had lurked the wolf and the bear. They turned aside devastating torrents, they restrained by means of dykes rivers accustomed to overflow their banks, and soon the deserts where before was heard only the cry of the owl and the hiss of the serpent were changed into smiling fields and fat

* Hurter, "Geschichte Papst Innocenz III. und seiner Zeitgenossen."

pasturage. The love of solitude, the desire of placing by every means possible a check to human passion, inspired them to seek out sites the most unhealthy and to render them by cultivation not only sanitary but even profitable. Modern writers recognize that Italy, devastated by the repeated incursions of Barbarians, owed its restoration, its tranquillity and the preservation of the last remains of art to the monasteries. Wherever we see them rise we see agriculture reappear, — the people relieved from their burdens, and kindly relations established between the master and the slave.

In the twelfth century impenetrable forests still covered the valley of the Jura. A monastery of the order of Prémontré cut down the first trees in their forests and attracted there the first colonists. A monastery of the order of Cîteaux had but a short time previously restricted within its banks the river Saone, which covered with its overflow the foot of Rodmont. It cleared the soil of the virgin forest where now is situated the little city of Rougemont with its two thousand inhabitants. At great expense and by almost superhuman effort dykes were opposed to the waves of the ocean, and they snatched from the element a soil which the work of man changed afterward into fertile fields. Marshes became arable land and the home of man. The monks loved to acquire these marshes in order to render them amenable to cultivation, and frequently even their monasteries rose out of the bosom of the waters. When it was impossible to drain them or when economy demanded it, they brought straw and laid it down in bundles and upon these bundles earth was placed. They dug out ponds into which they collected the superfluous waters by tiles used to drain the land. In this way the monastic orders extended the cultivation of the soil from the south of Europe even to the most distant north. They facilitated communication between different points and were the organizers of different kinds of industry. Sweden owes to them the perfection of its race of horses and the beginnings of commerce in wheat. On the island of Tuteron, where was formerly located a monastery of the order of Cîteaux, plants still grow spon-

taneously which in the neighborhood one is compelled to cultivate with care. The Abbot William brought the first salad from France into Denmark. If in the eleventh century England could boast of an agriculture more advanced than many other countries, if it presented less forest and heath and more cultivated lands and fat pasturage, it owes it to the zeal of the monks who had found there in early times a hospitable welcome. It was the monks who in Flanders cleared the forests, drained the marshes, rendered fertile the sandy lands, snatched from the sea its most ancient possessions and changed a desert into a blooming garden.

There were certain abbeys, especially in England, that took the greatest care not to clear the country of all trees. It is related of Alexander, the first abbot of Kirkstall, that, foreseeing the necessities of the future, he forbade the cutting down of the vast forest he had acquired by divine protection, and preferred to purchase elsewhere the timber he required in erecting his large buildings. The monks of Pipwel in Northampton did not cease to plant trees in their forests and were said to watch over them as a mother over an only child. For their own private necessities they made use of dead, dry wood and reeds.

As a rule, the monks took great care in the cultivation of their land to conform to the laws of climate, soil and locality. In the north they devoted themselves especially to the raising of cattle, and in these countries the greatest privileges that could be given them were woods and the right to allow the swine to wander in them. In other countries they occupied themselves in the cultivation of fruit trees, the improvement of which was their work. It was the celebrated nursery of Chartreuse of Paris that up to the epoch of the Revolution furnished fruit trees to almost the whole of France, and the remembrance of their labors still lives in the name of certain delicious fruits, such as the *doyenne* and *bon chretien* pears. The finest orchards and vineyards belonged to the monasteries. All the chronicles speak of the cultivation of Mt. Menzing in the canton of Zug, which produced abundantly wheat and fruits and particularly nuts. The

friendly relations existing between the monasteries, the interchange of visits between the monks of the different monasteries, were of great advantage, for foreign plants and fruits were exchanged and cultivated.

The monks were the first to devise tools for gardening. They had calendars in which were set down all that experience had taught them respecting the breeding of cattle, the sowing of land, the harvesting of crops and every kind of plantation. William of Malmesbury boasts of the fertility of the valley of Gloucester in wheat, in fruits and in vineyards, adding that the wines of this province are the best in England and scarcely yield in quality to the wines of France. The best vineyards of Germany belonged not only to the monasteries, but had been planted by them, and we are forced to recognize the judgment with which these first planters selected their grounds. Tradition tells us that the monks of St. Peter in the Black Forest planted the first vines in the neighborhood of Weilheim and Bissingen, and the wine of this latter place is still the best in the whole country. The monks of Lorsch planted the vineyards of Bergstrasse and those along the banks of the Rhine. Epicures when drinking the delicious wine of Johannisberg still recall with gratitude the monastery of Fulda. In every country of Europe the monks stimulated the progress of agriculture as much by their personal efforts as by the example they gave to others. It was fortunate for the world that the first founders of the religious orders enjoined upon their disciples manual labor rather than spiritual, and that the first monasteries were founded not in the cities, as those which were founded later, but in the wildest and most unfrequented spots, that were transformed by their activity and labors into the homes of thousands of peaceful and industrious men.

What I have said of the monks of Europe is equally true of the missions in this country. There was the same evolution and at their dissolution the same fate.

When Father Junipero Serra and his followers came as Franciscan missionaries and established the chain of missions at San Diego, Los Angeles, San Gabriel, Monterey, Santa

Clara, San Buenaventura, San Juan Capistrano and San Francisco (Dolores), and San Lous Obispo, between 1767 and 1783, they estimated that there were over eighty thousand Indians in Alta California. At the mission of San Gabriel there were about seven thousand. The priests wrote that they had never found anywhere such tractable and energetic savages as those in California.*

After a few years the missionaries were never afraid to trust their lives and property among the Indians. The fathers taught the Indians at the several missions to sow wheat, grind corn, till the soil, to raise herds of cattle, to dress hides, and to make their clothing. The priests brought grape-vines, olives, fruits and nuts from their old homes in Spain and Castile, and taught the Indians how to cultivate them in California soil. In time the missionaries had induced all the Indian families to come and dwell in pueblo communities about the missions, where the Spanish padres were monitors, socially, industrially and religiously. When the missions were legally disestablished by order of the Mexican government, and the lands were partitioned to Mexican families, the herds and flocks sold, and the missionaries told to seek other walks of life, the Indian pueblos soon went to ruin. The Indians themselves wandered aimlessly away, settling in one place until driven to another by the white man. No one attempted to preserve their moral condition, and to the natural savage inclination for licentiousness was added the bad example of the low whites of the frontier of those days.

My friends, I have outlined to you in briefest manner to-day the work of these grand old monks during a period of fifteen hundred years. They saved agriculture when nobody else could save it. They practised it under a new life and new conditions when no one else dared undertake it. They advanced it along every line of theory and practice, and when they perished they left a void which generations have not filled.

* Baneroft, "Pacific States;" Griswold, "Spanish Missions."

THE CULTURE OF THE CIVIC VIRTUES.

BY REV. CALVIN STEBBINS, FRAMINGHAM.

There are two classes of American citizens who make a great deal of noise (but of a very different kind), — the boaster and the grumbler. The one is a happy creature and wants everybody to be happy. He is a thorough-going optimist and loves to dwell on the bigness of our country and talk of “manifest destiny.” The other is unhappy. He is a thorough-going pessimist, and does his best to make everybody feel worse than he does. He is

More peevish, cross and splenetic
Than dog distract or monkey sick.

His mournful howl about the follies of the people is at times something dreadful. But the truth is, these two classes really form but one and may be denominated the “noisy class.” As we say, “extremes meet,” or better, as the old Greek had it, “Dry dust is mud’s own brother.” Edmund Burke, who understood both parties, warned men long ago against the liability of mistaking them for the whole community in his celebrated figure of “half a dozen grasshoppers under a fern making the whole field ring with their importunate chink, while thousands of great cattle repose beneath the shadow of the British oak chewing the cud, and are silent; pray do not imagine that those who make the noise are the only inhabitants of the field.” The noisy occupants of the field need not trouble us this afternoon.

In a general order, having for its object the improvement of the army, Lieutenant-General Miles has said: “It is essential that the army shall fully understand the character of our government, shall realize the benefits and prerogatives granted by our constitution and be familiar with the

brilliant achievements of our arms as recorded in our past military history." What our general has wisely declared to be essential to the making of a good soldier is equally essential to the making of a good citizen. He rightly appeals to the culture of the civic virtues, for they are the soil out of which the other virtues grow. Indeed, if you are to have a good soldier you must have the materials out of which to make him, and these materials are found only in the good citizen.

At the beginning of the civil wars in England the Parliamentary generals were beaten on almost every field. They could not bring their men to face the Cavaliers in battle. At last a Huntingdonshire farmer came to the front and asked for honest men who had a spirit in them for this business. He said, and his words have the ring of democracy in them: "I rather have a russet-coated captain who knows what he fights for, and loves what he knows, than that you call a gentleman and is nothing else." It is enough to say that Col. Oliver Cromwell and his troopers never stopped, when they found the enemy, to count noses, and were never beaten.

It requires great courage to be an American citizen, for the first thing he has to learn is the great and, to some, the very disagreeable truth which our English friends are continually telling us in a very wise and patronizing way: "Your government is nothing but an experiment, you know." Yes, we do know it is an experiment, and we know something more about it that is quite important: it is the greatest experiment, with, perhaps, the exception of Christianity, that the Eternal has tried on this globe. It is an experiment to see whether, contrary to all experience in the past, the social pyramid will stand more steadily on its base than on its apex. It differs from any other experiments that have been made in government in this, that the base on which the pyramid stands is made up of local town meetings which are represented in and through every layer of which it is composed to the top. In this condition of things the success of the experiment depends wholly upon the moral virtues, the intelligence, the loyalty and

the courage of the people who make up the town meeting. I may, perhaps, best illustrate the civic virtues by speaking of some of the dangers to which a government like ours is exposed.

Foremost among these is unbounded material prosperity.

Ill fares the land, to hastening ills a prey,
Where wealth accumulates and men decay.

Unprecedented material prosperity like ours always, and everywhere, softens the muscles and relaxes the moral energies; it inaugurates an era in which comfort is worshipped; in which the enjoyment and the prosperity of the individual is put above the interests of the whole community; in which men seek shelter under what they are pleased to call the domestic virtues and forget the civic, and the service of the State becomes the service of the individual: and in which a tendency grows up to convert public trusts to private uses.

The old distinction between the things of Cæsar and the things of God disappears altogether, for Cæsar has the whole. The real confession of faith is one in which faith and works are not likely to have any trouble, for it is a full and complete surrender of the individual to Cæsar. As Lowell states it in the "Pious Editor's Creed:"—

I du believe thet I should give
Wut's his'n unto Cæsar,
Fer it's by him I move an' live,
Frum him my bread an' cheese air;

I du believe thet all o' me
Doth bear his superscription,
Will, conscience, honor, honesty,
An' things o' thet discription.

But be of good cheer. Let Mammon, whose looks and thoughts

Were always downward bent, admiring more
The riches of Heaven's pavement, trodden gold,
Than aught divine or holy else enjoyed
In vision beatific, —

let Mammon pile up his millions. It is well to remember that some good men acquire wealth and add new lustre to

the shining metal by their use of it, and what is more important to remember is this, that the chink of Fortunatus' gold has never yet dulled the ear of the body of the American people to the call of public duty.

Goethe has made reverence the beginning of science and philosophy and religion. One of the greatest thinkers of our time, James Martineau, has made it "supreme among the springs of action." Now democracy, certainly in its present state of development, as we see it to-day is not a good school for the culture of a reverent spirit. Democracy is doing and has done in the past a great work in destroying harmful social distinctions, but there is a tendency to carry this so far that man ceases to win the respect that is due to him as man; laws and institutions which ought to be held in high respect lose their moral power, and superior education and abilities lose the power for good that is by right their peculiar privilege. All things and all men are reduced to the same level, and that a low one. The spirit that democracy often engenders is well stated by a miner in a far western town when he describes Boston as "a city in whose streets respectability stalked about unchecked."

Human laws are not perfect; they partake of the limitations of the makers; but, nevertheless, good order in society and a good measure of justice between man and man have their origin in reverence for law. Suspend the operations of law, and civilization would cease to be; barbarism would draw its dark pall over human life and all its great and cherished interests and its cultivated affections. As that personification of Yankee wit and wisdom, Hosea Biglow, has said:—

The plough, the ax, the mill,
All kin's o' labor an' all kin's o' skill,
Would be a rabbit in a wile-cat's claw,
Ef't warn't for thet slow critter, 'stablished law;
Onsettle thet, an' all the world goes whiz,
A screw's gut loose in everythin' there is.

To realize the value of law is one of the most important objects to be aimed at in the education of an American citi-

zen, and when the summits of the great principle are reached we shall be able to feel as well as say : —

O law, fair form of liberty ! God's light is on thy brow.
O liberty, the soul of law ! God's very self art thou.
O fair ideas ! we write your names across our banner's fold ;
For you the sluggard's brain is fire, for you the coward bold ;
O daughter of the bleeding past ! O hope the prophets saw !
God give us law in liberty, and liberty in law !

It is the right and the privilege of every American citizen to criticise any public official or censure any public measure ; but there is a wide difference between criticism and abuse. I may use as an illustration the treatment accorded the chief executive of a great people. The President of the United States is certainly entitled to the respect of all those who have any confidence in a representative form of government, for he occupies his high place because the people have confidence in him. Yet abuse of every description has been poured out upon our presidents from the first to the last. Their motives have been impugned and their private characters have been attacked in every conceivable way. You have only to recall the last three gentlemen who have been called by the people to occupy that exalted position to corroborate what I say. But their share of abuse was no worse than the abuse that our fathers heaped upon Washington and Adams and Jefferson, and that, within the memory of some of us, was heaped upon Lincoln. The people's choice should be respected, and I submit that we who claim to believe in the people have no right to “throw mud” at the representative of the people who has been called to the highest place we have to give.

The American people cannot be reminded too often that our method of selecting a chief ruler has produced better results than any other method known to history. We have had some twenty-nine presidential elections. Take the twenty-nine kings and queens of England from Henry III. to Edward VII., and I submit, without fear of contradiction, that the people of the United States have chosen abler rulers and better men to the presidency than royal descent has

given to the throne of England. We may be sure of this, at least: we have had no such character as Charles I. : nor “the barbarous dissonance of Bacchus and his revelers” with Charles II. leading the rout; neither have we had anything like the Georges, of whom a great Englishman wrote — and he wrote the verdict of history : —

George the First was reckoned vile,
 Viler George the Second;
 And what mortal ever heard
 Any good of George the Third?
 And when from earth the Fourth descended
 Heaven be praised, the Georges ended.

Yet these four Georges ruled England longer than our republic has existed. On the other hand, where in the long list will you find a match for Washington or Lincoln? Alas for English royalty, the only ruler England ever had that history would for one moment tolerate beside them was not of royal descent and is not counted among her kings — Oliver Cromwell. And this is not all; before the great captain who led us in the civil war all her warrior kings “hide their diminished heads.” Let us think of the facts when we talk about our presidents.

Are you disturbed because the American people choose for their rulers the sons of farmers and rude western attorneys, — men born outside the charmed circle of gentle blood? There is one other institution on earth that does the same thing. It is the oldest in the world. “The proudest royal families,” says Macaulay, “are a matter of yesterday, when compared with the line of supreme pontiffs. The church of Rome was great and respected before the Saxon had set foot on Britain, before the Frank had crossed the Rhine.” But like the American republic, it recruits its strength from the common people. “Urban II. and Adrian IV. sprung from humblest origin; Alexander V. had been a beggar boy; Gregory VII. was the son of a carpenter; Benedict XII., of a barber; Nicholas V., of a poor physician; Sextus IV., of a peasant; Urban IV. and John XXII. were the sons of cobblers, and Benedict XI. and Sextus V. of shepherds.”

Tell us not of Plantagenets,
Hapsburgs and Guelphs, whose thin bloods crawl
Down from some victor in a border-brawl.

we spring from the blood of the people.

We, as a people, are very impatient of and sensitive to the criticism of foreigners. Yet the Tory press of England only reflects the spirit of our own statements concerning our people, our institutes and our government. One would very naturally think, should he read some of our own newspapers in times of great political excitement, that we were just on the point of open rebellion, and that our public men were a pack of self-seekers, without moral principles and wanting what most scoundrels have — brains. We are continually complaining of a want of statesmanship and lamenting the absence of great men. This statement, however, is not true. It is very difficult to see a great man when he is near to you. No man is a hero to his valet. We look back to the time when Webster, Clay and Calhoun were in the Senate. We call it an age of giants, but Webster did not enter upon his greatest influence until a decade after his death. John Marshall had to wait a century for the people to recognize his colossal genius, and we forget that he was burned in effigy by his own generation. We see these men in a very different light from their contemporaries. We have never lacked great men, and I do not believe we do now or ever shall.

But, supposing the leading men of this generation are inferior to those we have produced in time that has passed, is there any danger overhanging the republic on that account? It is only in an absolute monarchy that a great man finds an open field for his powers. In a republic or a monarchy like that of Great Britain, he is checkmated by forces too strong for the individual to contend with. In a government like ours there is a factor which, when it makes itself heard, no statesmanship, however astute, can successfully oppose. This is “the common intellect, rough-hewing political truths at the suggestions of common wants and common experience.” “The changes,” says John Stuart Mill, “and the greater changes which will be made in our insti-

tutions are not the work of philosophers, but of the interests and instincts of large portions of society recently grown into strength." What is true of England is eminently true of America. In a government of the people, for the people and by the people we must not overlook these "interests and instincts," which grow with increasing intelligence. Were the Jewish Messiah elected President of the United States he would have to keep his ideas of the Kingdom of God in abeyance until the people had worked them out in their own way. There is, then, nothing so important as the intelligent, thinking and courageous citizen.

But in order to think highly of mankind, as Helvetius has said, "you must not expect too much of them." The people climb to the summits of great ideas very slowly; they have no wings and do not fly, but *toil* upwards with weary feet, and, sometimes, with doubting hearts. To believe in the people — that they are after all the democracy of God, that there are great possibilities in them, that by and by they will carry their "banner full high advanced" — is a *civic virtue* of the highest importance and rank.

We are naturally a conservative people, and this characteristic makes us a great deal of trouble, for, as the late Walter Bagehot has said: "One of the greatest pains of human nature is the pain of a new idea. It is, as the common people say, 'so upsetting'". The newcomer is not a peaceable tenant of the mind but makes trouble at once with all the former occupants, and you are in constant danger of having your old favorites disturbed or losing some of your old pets. The air to-day is full of new ideas on all subjects pertaining to human welfare, and it is both un-American and unpatriotic to dismiss them without a thought.

Then, again, there is the bias of party. God grant that the time may never come when there will be no parties in our land. I confess to having a great liking for my old party prejudices; they are encouraging to law and order and steadying to the individual in the discharge of his duties: but there is no call that we should follow the example of the Chinese and blacken our teeth because we think the devil has white ones.

The American citizen must keep the windows of his mind open on the whole circle of the horizon and fearlessly enter into the discussion of politics; for discussion not only incites to intelligence, but has incentives to progress peculiar to itself. Woe to the land where all men think alike, and woe to the land where every man has come to the conclusion that his own opinion is final! It is well to bear in mind the remark of Hamlet, made to his friend, in the play: —

There are more things in heaven and earth, Horatio,
Than are dreamt of in your philosophy.

That lowly virtue, humility, is a state of mind friendly to the truth, to progress, to patriotism, and to good citizenship.

But it may be said this is all well enough for small States, but it will never do for a great empire like ours. All history shows that great empires can be held together only by military force, and when that fails anarchy is the last result. This is very true in regard to all the empires of which history gives an account, and it will, without any doubt, be the fate of some of the great empires of to-day. But size does not seem to have been the cause of their ruin, for smaller States have shared the same fate. They were all trying to make the social pyramid stand on its apex rather than on its base. The control of things in the remotest corner of the Roman Empire emanated from Rome, and this is the difference between the Roman Empire and the American Republic; no such power emanates from Washington to any town in the land. We have an institution bequeathed to us by our Teutonic ancestors which was developed to some extent in England and has been given a free chance to grow in America. It is a principle so common among us that it seems ridiculous to speak of it as anything important or wonderful: I mean the principle of local government for local purposes and a general government for general purposes. It was truly said by the late John Fiske that "the town-meeting principle lies at the bottom of the political life of the United States." Here, in the

local government, the people have the largest liberty to adjust and manage their own affairs. The federal principle, when broadly stated, is very simple, and it is this local self-government for local purposes and representation in the councils of the State and nation for general purposes.

We have always been an aggressive people. In the last century we have extended amazingly our boundaries, by purchase, by treaty, by conquest and by annexation. As the population advanced in the new territory we have always instituted local self-government, and towns or counties and States have grown up in the wilderness, until nineteen flourishing commonwealths have been added to the federal Union out of what was once foreign territory. They have become a part of the nation ; as Chief Justice Chase of the supreme court has stated it, admitted into “an indestructible Union composed of indestructible States.”

The strength of the federal principle has been severely tested in this country. Slavery, a patriarchal institution supposed to have some scripture in its favor, led a cluster of States to renounce their allegiance to the Union and to set up a government for its protection ; but even here they paid the constitution the highest compliment any document ever received by modelling their new government after it. Until the civil war no one had any idea of the power of the federal principle. It triumphed in war, but it was equally triumphant in peace. The cause of the contention removed, there was nothing so natural as for the States to take their places again in the Union. The expectations of so-called statesmen were disappointed. No standing army was needed, and the question of the dismemberment of this republic is settled.

Neither had anybody any idea of the spirit of the federal principle. During the war we used to sing “Hang Jeff Davis on a sour apple tree,” but when the war was over our flag, a creation of immortal beauty, came back to us unstained by the blood of a single rebel. There is not a child or a woman in the whole south that can point to a southern soldier's grave and say : “My father or my husband was sacrificed to satisfy federal vengeance.” The president of

the confederacy and its greatest general were not even exiled, but died in their own homes and on their own beds ; the vice-president was elected to congress and served his State, as did many generals, in that capacity. You will hardly find a parallel to this in history.

And, finally, the American citizen must not be afraid of the legitimate results of his own principles. The idea of federal government is not confined by boundaries, or to be held fast in the limits of thirteen States ; it was not disturbed by the purchase of Louisiana or the conquest of California, and, while there is nothing of Roman imperialism in it, it is reaching out its blessings to vast areas and is already looking forward to the time when

The war-drum throbs no longer, and the battle-flag be furled
In the parliament of men, the federation of the world.

Do you ask me where the great school of the civic virtues is? It is not beyond the reach of the plainest American citizen. It is not hid away in the clouds ; you will not have to ascend up into heaven or travel far on earth to find it. You will find it in the humblest village in the Commonwealth. It will be opened at your next primary meeting, and also at the following town meeting, and if you are there you will have an opportunity to do something for good local government and for good representation in the general government. And to be able to discharge these duties as becomes a freeman, you will need all the intelligence you can bring to the work, and, perhaps, all the courage you possess.

PUBLIC WINTER MEETING
OF THE
BOARD OF AGRICULTURE,
AT
NORTHAMPTON.

DECEMBER 3, 4 AND 5, 1901.

PUBLIC WINTER MEETING OF THE BOARD,
AT NORTHAMPTON.

The annual public winter meeting of the Board for lectures and discussions was held in Northampton, on Tuesday, Wednesday and Thursday, December 3, 4 and 5. The meetings the first two days were held in Masonic Hall, and on Wednesday evening and on Thursday in City Hall. Notwithstanding a somewhat severe snow storm on Tuesday, causing great inconvenience in travel, the attendance was very gratifying, and the meeting on Thursday was one of the largest in the recent history of the Board.

Secretary Stockwell called the gathering to order at 10.30 o'clock A.M., and said: I have the very pleasant duty of calling upon the past secretary, the first vice-president of the Board, Hon. Wm. R. Sessions, to preside at these meetings.

The CHAIR. As is customary in these meetings, I will call upon the Rev. Mr. McMillan, pastor of the Edwards Church, to invoke the Divine blessing.

Prayer by Dr. McMillan.

The CHAIR. The Board has come to this beautiful city in this productive valley for its winter meeting, and our programme tells us that the mayor of the city is ready to welcome us here. I therefore call upon His Honor Mayor Watson.

Mayor WATSON. It gives me great pleasure, in behalf of the citizens of Northampton, to give to you a cordial welcome to the Meadow City, the Pearl of the Connecticut valley, one of the most beautiful valleys in the world. It always gives me pleasure to dwell upon and enlarge upon the beauties of this valley. I have seen grander, more magnificent, more picturesque, more awe-inspiring valleys, but the Connecticut, for quiet beauty, excels them all. Its

beauties impress me more and more from year to year, grow upon me as I see them from time to time. Of course you do not, at this season of the year, see it in its full beauty. You should visit it in June or October. But we welcome you to it at any time.

Northampton has, within a few years, changed its character greatly. Its industry has changed from one almost entirely agricultural to an educational centre, and with manufacturing interests, but the farming interest is still the preponderating interest in many respects, and I am happy to say that its thoughts and ways are guided and leavened largely by the stability and conservative views of the farmers of Northampton and the neighboring towns.

We are especially glad to meet you here, and the subjects which you intend to consider have a special interest for us, and we are in entire sympathy with your efforts to dignify and add pleasure to that most ancient and honorable and useful vocation of agriculture.

But the audience did not come here to listen to me or to hear me talk, and I will not detain them longer from that in which they are interested.

The CHAIR. The next number on the programme is a response for the Board of Agriculture by His Honor John L. Bates. I understand he is not present. If he were here he would make an eloquent address, which the Board of Agriculture would be proud of and which we should all enjoy. The kind and cordial welcome which the mayor has given us deserves a cordial response, and in the absence of the Lieutenant-Governor your humble servant, in the position of presiding officer, must thank him and the citizens of Northampton for the hearty welcome which they have extended to us.

The Board of Agriculture has met in Northampton once before, and the winter meeting held here then (1882) was a successful one. Our honored, valued and loved friend, the Hon. John E. Russell, then attended to the matters of the Board as its secretary, and the meeting was successful.

This is the thirty-ninth winter meeting of the Board, five of which have been held in this county. This Board has

met in Springfield twice, in Easthampton once, in Amherst twice, in Greenfield three times and in Westfield twice. So you see the plan of the Board to provide for the convenience of the farmers in the State attending these meetings has been pretty well attended to as regards the Connecticut valley.

The Board is always happy to meet in the Connecticut valley, for here we find more farms to the square mile than anywhere, unless in our western hills. The business of agriculture has always been, as the mayor has well said, productive in this valley. Here are some of the finest, most fertile lands of the whole State, and this State possesses some six thousand acres of level, Connecticut valley soil, which has produced in years gone by famous crops and made its owners wealthy, and the day will come again when the meadows of Northampton and Hatfield will bear as great a value as they did some years ago. We can see in the future a change coming over the agriculture of the country which is going to benefit these lands, and instead of their going begging for purchasers, they will be sought after as they were years ago. The owners of these lands, when I was a boy, years ago, — more years than you may think, possibly, — were called the river gods, and they were among the most influential people in the State of Massachusetts, looked up to by the citizens of Boston as strong men of the State, who held their places with the educated, the college-educated men, with the professional men, with the merchants of Boston and the large cities, and to-day I am convinced that the farmers of the Connecticut valley are not inferior to their predecessors, although they are too modest to force themselves forward as some of the other professions do.

But, as Mayor Watson has well said, you did not come here to hear me talk, and having once more thanked the mayor and the citizens of Northampton for the cordial welcome to this city, and expressing the hope that this Board may continue to be interested in the people of Northampton and to interest them, I will come to the regular programme of the day.

The first lecture is on “Modern Potato Culture,” by Dr.

Charles D. Woods, Director, Maine Agricultural Experiment Station. This is, without doubt, a question which comes home to the people of all the eastern States, to the people of Massachusetts, Connecticut, Rhode Island, New Hampshire and Vermont, as well as Maine, but Maine has land especially adapted to the production of potatoes, and the culture of the crop has been carried on there more extensively than in any other part of the eastern States, and I do not know but the whole country, and more successfully. The potato raisers of Maine recognize the assistance which has been given them by the Experiment Station of Maine, the bounty of the United States government having furnished the means for many large and exhaustive experiments which are of benefit to the cultivator of the potato in the State of Maine. The Board of Agriculture, its secretary, and its committee, have been to Maine to ascertain who the man is that can tell us most about the successful modern culture of the potato, and the man is Dr. Charles D. Woods, and I now introduce him.

MODERN POTATO CULTURE.

BY CHAS. D. WOODS, DIRECTOR, MAINE AGRICULTURAL EXPERIMENT
STATION.

The potato is so generally and so extensively grown, we are so familiar with its qualities and the various methods of culture, that most farmers are very positive as to the best method of growing this crop. During the past twenty-five years hundreds of experiments have been made at experiment stations and by practical growers, and the results from experiments in propagation and culture are so conflicting that the careful student will be very slow in drawing conclusions. While he will be convinced that there are ideal ways of treatment under certain conditions, he will be equally convinced that under different conditions very different practice will be necessary to insure the best crop. In potato growing, as with most farm operations, the soil and atmosphere are such determining factors that there is no best way. Each farmer who would grow potatoes to the best advantage must be sufficiently intelligent to understand the conditions of the soil on his own farm. The methods of preparation of soil, of planting, cultivating and fertilizing the crop, depend largely on the character and condition of the soil and the season. If I were to give you the exact practice which is so successfully used on farms in Aroostook County of my State, and you should adopt it, it might be fatal to the production of a crop on your soil. No man can afford to blindly follow methods of his neighbor or those of public speakers unless the conditions are practically the same. So, with the distinct understanding that I do not expect to be able to give you specific directions for your conditions, I shall try and outline some of the methods which are followed under different conditions of soil and climate with success.

THE SEED.

The selection of seed is important in the planting of any crop, but it is especially so in propagating the potato, because we do not plant the true seed but a tuber. A true seed is the result of a union between two incomplete germs of life (usually derived from different flowers in the same plant and often from flowers of two different plants), and partakes of the qualities of the parent plants, and is apparently affected by the qualities of preceding generations. A tuber is derived from one complete germ of life, and partakes, with very little tendency to deviation, of the qualities of the life from which it is derived. It is not a new creation by the uniting of two life germs, but is simply the extension of one old life. A true seed contains one germ of life supplied with a limited amount of plant food. Different seed of the same kind have practically the same amount of plant food. The tuber contains many germs of life (buds), and there is great variation in the amount of plant food stored up to supply the varied members of life germs. Unequal as this amount is in different tubers, the inequality is, unless great care is taken, greatly increased in cutting seed for planting. A true seed is inclosed in covering which keeps out, to a great extent, air and water until it is placed in earth, when warmth and moisture start the germ life so that it bursts the covering. The tuber has no such protective covering. The air and moisture often greatly injure it before the season for planting comes around, unless the grower makes an especial effort to keep it where heat, light and moisture are just right to maintain it at its best.

At planting time many farmers plant the potatoes they may chance to have, regardless of their condition, and cut them in small pieces, that they may use as few bushels as possible. And thus, with the interior of the tuber exposed to the action of the soil, the cut tuber, still bleeding, is placed in the soil, with no thought of how much has been done to weaken the power of the potato and how much it has been handicapped in its struggle to form a young plant and perpetuate itself. The results of the investigations at experi-

ment stations and by practical growers, while not always uniform, in general indicate as follows regarding the care and selection of seed potatoes.

The seed should be from mature but not over-ripened potatoes. It should be kept in the dark in a not too dry atmosphere and as far as possible at a temperature of 33° to 40° F. The weight of the cutting is more important than the number of eyes, *i.e.*, the heavier the piece the larger the yield. Whole potatoes give heavier crops than cuttings. In general, the "seed" ends of the tubers give larger yields than the "stem" ends. While under careless management northern grown seed frequently gives larger yields than southern, the careful selection and storing of seed are of more importance than changes of latitude. Cut seed should be allowed to dry somewhat before being planted. If it is to be planted soon after cutting it should be covered with plaster, or some other material, to prevent "bleeding."

FERTILIZERS FOR POTATOES.

Analysis shows that the composition of potatoes, so far as nitrogen, phosphoric acid and potash are concerned, is fairly uniform, and that each 100 pounds of fresh potatoes carry about .31 pound of nitrogen, .13 pound of phosphoric acid, .48 pound of potash and .01 pound of lime. If we assume these figures to fairly represent potatoes as grown in New England, a crop of 200 bushels, weighing 6 tons, would remove 37 pounds of nitrogen, 16 pounds of phosphoric acid and 58 pounds of potash.

If the amounts and proportions of fertilizing elements removed by a crop could be taken as a guide in preparing a field for that crop, the problem of supplying the proper amount and kind of plant food to the soil would be much simplified. To manure a field for a crop of potatoes, nitrogen, phosphoric acid and potash would have to be added in about the proportions given above, and in sufficient quantity to supply the vines and tubers the land was expected to yield. A formula made up on this basis would be very different from any mixed fertilizer on the market, and would contain the fertilizing elements in about the fol-

lowing proportions : nitrogen, 5 parts, phosphoric acid, 2 parts, and potash, 8 parts. Twenty-six different brands of so-called potato fertilizers sold in Maine had the following composition : —

| | Nitrogen (per Cent). | Available Phosphoric Acid (per Cent). | Potash (per Cent). |
|----------------------|-------------------------|---|-----------------------|
| 12 brands, | 1.5-2.5 | 8-9 | 2-3.25 |
| 6 brands, | 2-2.5 | 6-9 | 4-6 |
| 8 brands, | 2.5-3.5 | 5.5-8 | 7-10 |

The first twelve brands mentioned cannot properly be called potato or special fertilizers as their composition is practically the same as all general purpose goods. The formulas of the last eight approximate more nearly to the popular idea of what a potato manure should be, but even these carry much more phosphoric acid in proportion to the nitrogen and potash they contain than is found in the plants or in farmyard manure. It is possible that in using commercial fertilizers more phosphoric acid is applied than is needed in many cases, yet there is not much evidence at hand in the form of accurate experimental data to prove this assertion. An analysis of the ash of the potato shows it to be exceedingly rich in potash, and the fact has led many to believe that a potato manure should contain a large amount of this element, but when we consider the small amount of ash a potato contains, we find the amount removed by an ordinary crop (58 pounds) is not greater than is taken up by many other farm crops. Two tons of mixed hay would take away 63 pounds, while two tons of red clover would remove 88 pounds of potash.

In preparing a field for any crop it is more essential to consider the special needs of the soil, to render it fertile, than the special needs of the crop to be grown upon it. While it is true that some plants take up more of some one element than others, the difference is insignificant when compared with the difference in soils. The soils of New

England are extremely variable in character and composition, and it is therefore impracticable to make a fertilizer formula for potatoes or any other crop that would be applicable in all cases. Each farmer who uses commercial fertilizers extensively should experiment with unmixed goods enough to determine to what elements his soil most readily and profitably responds. Some marl or limestone soils are quite rich in phosphoric acid, and consequently a fertilizer containing a small amount of that element and relatively large amounts of nitrogen and potash would give best results, while some of our granite soils and clay loams are quite rich in potash, and respond best to a fertilizer containing relatively large amounts of phosphoric acid.

A study of the experimental data indicates that the potato plant thrives best in a rich soil which is abundantly supplied with all fertilizing elements. In the early stages of its growth, when the vines are forming, the demand for nitrogen is particularly large, and for this reason a potato fertilizer should contain quite a part of its nitrogen in a soluble, immediately available form. Later in the season, when the tubers are forming, large amounts of phosphoric acid and potash are required, also a bountiful supply of water to take up the plant food and transmit it through the vines.

THE WATER SUPPLY.

There is no farm crop that is more easily, speedily and greatly affected by the supply of moisture than is the potato. It has been found by experiment that it takes about 425 tons of water to grow a ton of dry matter of potatoes. A crop of 200 bushels per acre would therefore require approximately 650 tons of water, equivalent to a rainfall of nearly six inches. Because of its need for large water supply, and its remarkable susceptibility to climatic conditions, it follows that the average potato yield is affected more by water supply than by lack of plant food. The selection of soil and methods of culture must be with this fact in view if success is to be had. The liberal application of fertilizers or the presence of large amounts of readily available plant food will prove of but little value if the moisture supply is

deficient. It is also true that too much water will check the growth as quickly and effectually as too little. In most seasons here in Massachusetts, as in the southern and western parts of my State, year in and year out you probably suffer much more from droughts than from too much wet. In Aroostook County, in northern Maine, with a gravelly loam soil underlain by broken ledge so as to form natural drainage, with a copious rainfall during the growing season, the method of culture is very different from what your conditions demand. Although better methods are frequently used and with profit, plowing in the fall, and once harrowing in the spring, will, in Aroostook County, Me., suffice for preparation of the soil, and cultivating two or three times, and finishing with a shovel plow or other hilling device, will in most seasons give a fair crop.

Here in Massachusetts the conditions of climate are so different that the treatment must be very different. Too much attention to the fitting of the soil for the crop can hardly be given, for no amount of after tillage can overcome neglect in preparation. Deep and thorough plowing and harrowing, so as to make a perfect seed bed, not only establishes an earth mulch so as to prevent the loss of moisture of the spring rains, but it so fines the soil that the plant food contained in it becomes accessible to the growing plant. The conservation of moisture by frequent tillage is not understood or practised as it should be. The old notion that potatoes should be hilled, and that tillage should cease as soon as the potato is in bloom, is wrong for most situations. Hilling is frequently practised so as to keep the tubers from becoming exposed to the sun; this is not necessary if the soil was properly prepared. On hard, compact soil the potato will, because of less resistance of the soil, push out of the ground. This will not happen in deeply worked land.

INSECT ENEMIES OF THE POTATO.

Indispensable as an abundance of plant food and moisture are to the successful potato culture, healthy foliage is another requisite of equal or even greater importance. There are two insects which annually do great damage to the potato

plant. One, the Colorado potato beetle, or potato bug, as it is commonly called, is easily and generally fought: the other works its mischief without attracting much attention.

Flea Beetle.

Early in the summer, usually when the potatoes are not more than two or three inches high, a small beetle, not more than a tenth of an inch long, appears and begins feeding upon the young leaves. The beetles eat small cavities in the tender foliage, often to such an extent that the plants are ruined. After they have been feeding for a little time the leaves will be found perforated with small circular holes, as though made by fine shot. If the beetles do not destroy the crop, the injured parts afford a foothold to the spores of the early blight, and these two pests together may do what neither would be able to do alone in destroying the crop.

The beetles are very active, and their name, flea beetle, is appropriate. They often escape notice, for when disturbed they jump off the vines at once. No uniformly protective measures are known. Spraying with the arsenites, dusting young plants, while the foliage is wet, with tobacco dust, lime, ashes or plaster, have been tried with more or less of success. On the whole, the most successful remedy tried by us is the Bordeaux mixture (formula 2, page 60). This does not kill the beetle but makes them unhappy, and to a great extent drives them from the vines. If applied with an arsenite (formula 3 or 3a, page 61) it will be more effective, and any early appearing potato bugs will be destroyed at the same time. The early application of Bordeaux mixture will also protect the already formed leaves from the early blight.

The Colorado Potato Beetle.

This pest, originating in the Rocky Mountains, where it lived upon weeds, found that it preferred the potato to its original food, and spread in a few years' time over the whole country. While it prefers leaves of potatoes it will eat the stems or even the tubers if nothing better offers. Its very greediness suggests the remedy, poisons. No adequate sub-

stitute for the arsenical poisons has as yet been found, when all things are taken into consideration. Something only mildly poisonous, such as Bug Death (practically impure zinc oxide, finely ground), will, if liberally applied, free the vines from this pest, but such things are expensive and time consuming in their application. The arsenical insecticides are best, applied with water, in the form of a fine spray, as soon as the slugs appear. To kill all the bugs the poison must be distributed over the entire plant. Unless applied in connection with Bordeaux mixture it is safest to use lime with all arsenical compounds. The applications should be repeated as often as necessary (formulas 3, 3a, 4 and 4a). Some of the cheaper arsenoids are as effective as Paris green. There is no reason for using them or Paragrene in place of Paris green unless they can be had at a lower price. Lead arsenate is the most satisfactory of the insecticides used by the station. It is apparently slower in action than the copper compounds of arsenic, but it can be more evenly applied, and it adheres firmly to the foliage without burning. Early application, as soon as the eggs hatch, is important, because the young, small slugs succumb more readily to arsenical poisons than do the large, nearly full-grown ones.

The purity of Paris green can be quite readily and fairly accurately tested by dissolving the Paris green in strong ammonia water. If pure all of the Paris green will dissolve, the solution turning a deep blue color. Undissolved sediment indicates impurities or adulterations. Another test is to place a little of the Paris green between two pieces of window glass and rub them together. If the Paris green is adulterated with lime, barium sulphate, or similar white materials, the Paris green will appear to turn white in places. Paris green of good quality is intensely bright green and uniform. When adulterated, the green loses something of its intensity and is grayish green and is not always uniform.

Although the purity of the Paris green is of the greatest moment, its mechanical condition is also important. To thoroughly protect the plant it is necessary that the poison

be thoroughly distributed. It follows, therefore, that of two equally pure greens, the one that is in the finer powder will prove the more effective. In our experience there is greater danger of purchasing imperfectly pulverized than adulterated Paris green.

BLIGHT — RUST.

There are a number of fungous diseases to which the potato is subject which affect the foliage and annually cause large losses to the grower. Two of these so-called blights are very prevalent in New England, and there is no year but what they do much damage and in some seasons completely ruin the crop over large districts. There is no subject relating to potato culture which is now of so much importance as the blights to which this plant is liable. There is very little doubt that these enemies have come to stay, and that, while in certain seasons and localities their ravages may be less than others, they are diseases which must be yearly taken into account in order to insure the success of the potato crop. There are two kinds of blight, the early and the late. It is difficult to decide which does the most damage, although they work in quite different ways. The early blight kills the tops and stops the growth of the tuber. The late blight not only kills the tops but causes the tubers to decay.

Early Blight or Potato Leaf Blight (Alternaria solani).

This disease is wide spread and causes great damage. As the name indicates, it usually appears early in the season. It is confined to the leaves and green stems, and is usually first noticed about the time the tubers begin to form. Hot, dry weather seems to favor its growth, and it is usually most severe on dry soils. In Maine this disease is most prevalent in the more southern parts of the State, while it does comparatively little damage in most seasons in Aroostook County, which is the great potato section of the State. There is probably no season but what it does a good deal of harm in Massachusetts. It is quite possible for the early blight to attack a field of potatoes and the owner not realize

the fact, but think the death of the vines is due to early maturity. This fact very likely explains why early blight does not attract so much attention as late blight.

The first indication of the disease is the appearance on the leaves of spots, usually grayish brown, which soon become hard and brittle. The disease ordinarily progresses slowly; the spots become gradually larger, particularly along the edges of the leaves. At the end of two weeks, if the progress of the disease is not interrupted, half of the leaf surface may be brown, withered and brittle while the remainder is of a greenish color. It may be three or four weeks before all of the leaves are entirely dead. In the mean time the stems keep green, but these finally succumb. The tubers stop growing nearly as soon as the leaves are attacked, and in case of an early appearance of the disease the crop is a failure.

Anything which interferes with the health of the plant predisposes it to this disease. Whenever the foliage has been injured, as by attacks of the flea beetle, the plant is more liable to the attacks of this fungus. Strong, healthy plants may be entirely free from the disease, while plants which have for any reason been checked in their growth are ready victims. Since vigorous plants are less likely to be attacked, one means of reducing the damage of this disease is to do everything that will keep the plant in healthy growth. Deep plowing, to furnish an abundant supply of plant food; frequent tillage, to conserve the moisture; large pieces of well-kept seed, and protection from the flea beetle and Colorado potato beetle will do much to ward off this disease.

Bordeaux mixture is an effective preventive of this as of other fungous diseases. It is not a cure but a preventive, and to be of much value it must be thoroughly applied before the trouble presents itself. If the potatoes are treated with Bordeaux mixture and Paris green or other reliable poison as soon as they are two or three inches high, and the applications are followed up after each six inches of new growth of tops, the foliage will be kept healthy and vigorous and free from insect pests, which will in itself tend to lessen the liability

of attack by this blight. The Bordeaux mixture forms a coating of copper which prevents the entrance of the blight into the tissue of the leaf.

Potato Blight, Late Blight or Rot.

This disease attacks the leaves, stems and tubers. Generally the first noticeable effect upon the leaves is the sudden appearance of brownish or blackish areas, which soon become soft and foul smelling. So sudden is the appearance of the disease in some cases that fields which one day look green and healthy may within the next day or two become blackened as though swept by fire. The rapid spread of the disease, which is caused by a parasitic fungus, is dependent in large measure upon certain conditions of moisture and heat. A daily mean temperature of from 72° to 74° F. for any considerable time, accompanied by moist weather, furnishes the best conditions for the spread of the parasite. On the other hand, if the daily temperature exceeds 77° for a few days, the development of the disease is checked. This fact explains why the fungus seldom occurs to any serious extent in sections where the mean daily temperature exceeds 77° for any length of time, and probably why it appears later than the so-called early blight.

This fungous disease is an old offender, and until quite recently has been regarded as the most serious enemy the potato grower has to deal with. Because of the difficulty, in mild cases, of distinguishing between this and the early blight, much of the damage of the latter has in the past been overlooked or attributed to the late blight. In all severe cases it is accompanied by a strong, disagreeable odor, which is easily recognized after it has once been experienced.

Unlike the early blight it attacks strong, healthy plants as freely and readily as those that have been partially eaten by the flea beetle or Colorado potato bug. The age of the potato plant has little influence upon the spread of the disease. Apparently the fungus is able to thrive upon all potato foliage, and old and young foliage and plants suffer equally from its attacks. The late blight not only stops the growth of the tubers but causes them to rot.

This potato disease is sometimes called the “downy mildew,” because in favorable circumstances a downy or moldy growth appears on the under surface of the leaves. This is white in color and of considerable density. The upper surface of the foliage does not show it, but wherever this frost-like growth is present it is almost certain that the potato rot fungus is present. This external growth consists of the spores and all the parts bearing them. These spores mature very quickly and have the power of immediately propagating the disease. They are small and light and are carried rapidly by the wind. It is these bodies that cause the rapid spread of this potato disease. After maturing from the leaf, some of these spores fall to the ground and by rains, or otherwise, are brought in contact with the tubers underground; here they germinate in the same way as upon the foliage. The color of the affected tubers changes, and unless the disease is proceeding with great rapidity, a brown, dry rot takes the place of the normal white color. Under favorable atmospheric conditions the disease may spread with such rapidity that a black, foul-smelling, wet rot results. The decay may take place slowly, and produce black, discolored places throughout the potato, or it may occasion its complete destruction. It is, of course, possible that the disease may be communicated to the tuber through the stem, but this is not supposed to be its usual method of attack.

Fortunately the growth of this fungus, with all its attendant ills, can be prevented by the timely and thorough application of fungicides. Bordeaux mixture is the standard mixture for this as for the great majority of fungous diseases. The same treatment recommended for early blight will be efficacious in preventing the late blight upon the tops and the subsequent rotting of the tubers.

Leaf Diseases, etc., resembling Blight.

Leaf burn or scald sometimes occurs and may be confused with early blight. The tips and edges of the leaves turn brown, and these discolored areas soon become hard and brittle. The burning or scalding may occur at any time and is the result of unfavorable conditions surrounding the plant.

Long-continued cloudy and damp weather, followed by several hot and bright days, is apt to result in the burning of the foliage. Leaf burn may also occur as the result of protracted dry weather.

Leaf poisoning or burning may occur where Paris green is applied to potatoes, and frequently it cannot be distinguished from early blight by an ordinary examination. It sometimes happens, therefore, that farmers are led to believe that their potatoes are affected with early blight and other diseases when the trouble has been brought on by themselves through the improper use of Paris green. Injuries resulting from the use of this substance are very apt to occur where flea beetles have eaten the foliage. The arsenic attacks the tissues at such points, and as a result more or less circular brown spots are produced, having for their centres the holes eaten by the flea beetles. By combining the Paris green with Bordeaux or with lime, these injuries may be avoided.

POTATO SCAB.

Scab is one of the most wide-spread diseases affecting the potato, and is unfortunately too well known to need description. While injuries of various kinds produce a roughened surface, which is sometimes mistaken for scab, it is safe to say that nine-tenths of what is known as scab is due to the attack of a minute fungus first studied and described by Dr. Thaxter, at that time mycologist to the Connecticut Experiment Station. The fungus will live in infested soil for years, and once established it is well nigh impossible to get it out of the land. Every precaution should be taken to keep land free from this disease. The most likely sources of contamination are potatoes used for seed, although farm manures may become a source of contamination, usually because of scabby potatoes or roots which have been fed to stock or added to the compost heap. All potatoes used for seed, whether apparently affected with scab or not, should before being cut be treated with a weak solution of corrosive sublimate (formula 1) or formaline (formula 1*a*) and then spread out to dry. After drying, the potatoes may be cut and planted in the usual way, care being taken not to

allow them to touch any box, bag or bin where scabby potatoes have been kept. All treated tubers should be planted, to avoid danger from the poison on them.

SUMMARY.

Keeping in mind, as I stated at the outset, that there is no best method for growing potatoes more than any other crop, and that conditions must modify practice, the following are the general points to be observed in successful potato culture.

The soil must be thoroughly prepared and fined. Wherever possible there should be both fall and spring plowing. The potato crop seems to demand a complete fertilizer for its best growth. Farm manures are best applied broadcast, and either plowed in or worked in with a suitable harrow. For most localities in New England flat culture is to be recommended. If the seed is to be dropped by hand the furrow should be opened with a shovel plow; if the planting is done by machinery it should be set so as to place the seed 2 to 4 inches below the surface. The rows should be 30 to 36 inches apart and the seed dropped 12 to 16 inches apart in the row. The light application of commercial fertilizers (500 to 1,000 pounds to the acre) for starting the crop will in most cases prove remunerative. This should be applied in the drill, care being taken that the fertilizer does not come in contact with the seed.

The seed should be well grown, medium sized and carefully kept in the dark and in the cold until time for planting. The seed should be soaked for two hours before cutting in a solution of corrosive sublimate (formula 1) or formaline (formula 1a); because of its less poisonous qualities formaline is to be preferred. After being treated, the seed should be spread out and carefully dried, and not allowed to come in contact with anything that has been used as a receptacle for scabby potatoes. This will prevent inoculating the soil with the fungus which produces scab, but will not kill the fungus already present in the soil. The seed should be cut into as large pieces as practicable, with not less than two eyes to each piece.

A few days after planting, the field should be harrowed with a fine-toothed harrow. This is the beginning of the soil mulch which it is important to keep over the land during the growing season so as to conserve the moisture. Furthermore, this first harrowing will kill the weeds which are beginning to germinate. It sometimes is practicable to harrow a second time before the potatoes are up. After the potatoes are through the ground the horse weeder can be used once to advantage. A fine-toothed cultivator should be used between the rows throughout the growing season, until the vines practically cover the ground. This can ordinarily be used to advantage as frequently as once in ten days, and should always be used after a rain of sufficient amount to compact the surface soil. It will, of course, be necessary to narrow up the cultivator as the vines begin to spread.

The fighting of insect and fungous enemies is as important as any other part of potato culture. The application of an arsenical poison is the only reliable inexpensive method for fighting the insect pests, and Bordeaux mixture is the only sure preventive of the blight. As soon as the potatoes are three or four inches in height they should be sprayed with Bordeaux mixture and Paris green (formula 3), or Bordeaux mixture and lead arsenate (formula 3a), repeated as often as the plants make five or six inches of additional growth. When the danger of the Colorado beetle is passed, Bordeaux mixture alone (formula 2) can be used. The spraying should be continued as long as the potatoes continue to make rapid growth. To ward off the blights it is necessary that each leaf be protected so far as practicable with a coating of copper.

Spraying is the most effective method of applying insecticides and fungicides. To obtain the best results the material must be *forced* through a proper nozzle so as to make a very fine mist. On small fields a force pump, a hose, nozzle and a barrel for holding the spraying mixture, and a wagon for carrying the above, would constitute the necessary spraying outfit. This form of an outfit can be used not only for spraying potatoes but also used on fruit trees. In large

fields, ten and twenty acres or more, it is advisable to use an automatic sprayer. In our practice we have found those that spray four rows better than where it is attempted to spray a larger number at one time. The Vermorel is the most satisfactory spraying nozzle which we have used. It throws a finer spray than others and is on this account easily clogged, and care must be exercised that the spraying mixture is carefully strained.

FORMULAS.

Caution. — The following formulas are for use on the potato. In many cases they are not adapted for more tender plants. Keep all poisons carefully labelled and out of the reach of children and animals.

Formula 1. Corrosive Sublimate.

| | |
|--------------------------------|-------------|
| Corrosive sublimate, | 2 ounces. |
| Water, | 15 gallons. |

The corrosive sublimate dissolves readily in water.

Formula 1a. Formaline.

| | |
|--|-----------------|
| Formaline (40 per cent solution formaldehyde), | 8 fluid ounces. |
| Water, | 15 gallons. |

Formula 2. Bordeaux Mixture.

| | |
|-----------------------------------|--------------|
| Copper sulphate, | 5 pounds. |
| Fresh lime (unslacked), | 5 pounds. |
| Water, | 50 gallons.* |

The copper salt is dissolved and the lime slacked in separate vessels. Dissolve the copper sulphate (blue stone) in about 2 gallons of hot water, in a wooden or earthen vessel, by stirring, or by suspending it from the top of the vessel in a cloth bag; pour the solution into the tank or barrel used for spraying and fill one-third to one-half full of water. Slack the lime by the addition of a small quantity of water, and when slacked add 2 or 3 gallons of water and stir freely. Pour the milk of lime thus made into the sulphate, passing it through a brass wire strainer of about 30 meshes to the

* An ordinary oil barrel holds about 50 gallons.

inch (No. 50), or through a cheese-cloth backed by common window screen. Stir constantly while adding the lime.

Much time may be saved by preparing stock solutions. While any proportions can be used, the following was found in the spraying experiments made by the station a convenient way : —

The stock solution of copper sulphate is made by weighing out 50 pounds of copper sulphate, placing it in a bag, and suspending it in the top of a barrel containing 30 gallons of water. The copper sulphate dissolves completely in a few hours. The stock solution of the lime is prepared by slacking 50 pounds of lime, and adding water so as to make up to 30 gallons, and straining through No. 50 brass screen cloth. To slack and strain this amount of lime takes less than one-half hour. For use, 3 gallons of each solution and 44 gallons of water make up the formula given above. The stock solution of lime should be kept well covered and be thoroughly stirred before dipping out.

Formula 3. Bordeaux Mixture and Paris Green.

| | | |
|-------------------|-----------|-------------|
| Paris green, | | ½ pound. |
| Bordeaux mixture. | | 50 gallons. |

Make a paste with the Paris green and a little water. Add to the Bordeaux mixture and stir thoroughly.

Formula 3a. Bordeaux Mixture and Lead Arsenate.

| | | |
|-----------------------------|-----------|-------------|
| Lead arsenate or disparene, | | 1 pound. |
| Bordeaux mixture, | | 50 gallons. |

Formula 4. Paris Green.

| | | |
|-------------------|-----------|-------------|
| Paris green, | | ½ pound. |
| Lime (unslacked), | | 3 pounds. |
| Water, | | 50 gallons. |

The standard remedy for the destruction of insects which eat the foliage or fruit. The lime is added to prevent the Paris green from burning the foliage. Slack the lime in a little water, make into a thin paste. Mix the lime and Paris green and add the remainder of the water. A stock solution of lime can be made as described under formula 2.

*Formula 4a. Lead Arsenate.**

| | |
|--------------------------|-------------|
| Lead arsenate, | 1 pound. |
| Water, | 50 gallons. |

Arsenate of lead acts slower as a poison than Paris green. It can be kept suspended in the water better than Paris green; it does not burn the foliage and sticks to it better than Paris green. For these reasons it proved, in our experiments in 1900, more satisfactory than Paris green.

Mr. CHRISTOPHER CLARK (of Northampton). I consider arsenate of lead by far the most effective insecticide that can be used. It is also a perfect remedy, almost, for the Colorado beetle. During the past two years I have noticed where persons have used Paris green on one field it had to be applied three or four times, and where arsenate of lead was used it had to be applied only once.

I consider the addition of glucose to the spraying mixture very important. I found that out by experiments on shade trees. In recent publications in regard to the use of arsenate of lead as a remedy against the Colorado beetle the glucose was left out, which should not be, because, if you spray the potato vines when they are not wet, or spray the trees when the leaves are not thoroughly wet, you will see the difference in the adhering qualities. The arsenate of lead will adhere to the leaves through the heaviest thunder storms, whereas with Paris green applied in the ordinary way a very large percentage would be washed off entirely.

I have found that arsenate of lead can be used freely upon maples, that have most delicate leaves; and it is a most effective remedy for the lice that attack the maple leaves and cause them to fall off quite early in the season as if they were dead, and because of which so many people have thought their maple trees were dying.

Professor Woods. Arsenate of lead is considerably superior to Paris green, and, while we have not experimented as to how little could be used, we have used a pound of arsenate of lead, as against half a pound of Paris green. At this rate

* Swift's lead arsenate or Bowker's disparene.

the arsenate of lead would cost four times as much as the Paris green.

Mr. CLARK. It makes very little difference if it does cost a little more, for it is far more effective. In regard to the mode of application, there is a pump made, the Ware pump, which was manufactured for the Gypsy Moth Committee and used in the application of the arsenate of lead. Farmers can club together and get one of these pumps, and it is astonishing how fast you can spray a field. You do it, of course, as the speaker has recommended, with a nozzle that makes a pure spray, so as to get a fine mist upon the leaf; and one man can work the pump, and by using that with a proper nozzle and hose of small size, you can go over an acre of potatoes in a very reasonable time.

Ex-Gov. W. D. HOARD (of Fort Atkinson, Wis.). Professor Woods spoke of the great necessity of a sufficient amount of moisture. I had a little occasion to demonstrate that. In my little town I had a small field of potatoes, and I divided it, and I employed the street sprinkler at an expense of about six dollars. I think there was in the neighborhood of about three-quarters of an acre in all. I had the street sprinkler come, and had him drench, at a certain period in the growth of those potatoes, just about the time they were setting, one-half of the field, and the other half I left undrenched. There was a very severe drought prevailing. I paid him six dollars, and received ninety dollars' worth of potatoes for the use of the six dollars in drenching, — that is, ninety dollars worth more of potatoes were grown on the portion thus irrigated than on the unirrigated portion. I have also noticed this in Colorado, about Greeley, which is a great potato raising section of Colorado.

We find in Wisconsin that we are greatly assisted in growing potatoes if we can secure a large amount of humus, and in all of Professor Woods' talk about fertilizers he had nothing to say about humus. Now, we get our humus by turning in heavy clover sod, if we can get the clover sod. On my own farm I have what is known as a piece of bottom land, down next to the Rock River, that has a good deal of black soil in it, and I grow potatoes there successfully.

Another point I wanted to speak to him in regard to was concerning blight. I have been very much impressed with the fact of the varieties resisting this blight. I had four varieties of potatoes this summer. It has been a very disastrous season in Wisconsin for potatoes, on account of the terrible drought. In those four varieties I have one old variety, the Rural New Yorker. That has a crinkly, strong, tough leaf. That withstood the blight, — has always withstood the blight with us there. All other varieties that have a smooth, tender leaf go down with the blight, — early blight or late blight, but mostly the early blight. Isn't there something in varieties that can be studied in regard to resisting blight?

Professor Woods. In the first place, as regards the conservation of moisture, if we were so situated that we could practise irrigation, and have men of intelligence enough to carry it out properly, I should be glad to have it done. I believe there are many farms in regions here, which have only occasional drought during the year, that can be irrigated; but the most of us must depend on conserving the moisture we have already in the soil, and that can be done by making a fine mulch over our fields. It is on the same principle that when we have oil in a lamp and have the wick turned up the oil will evaporate into the air. Turn the wick down, and it shuts off the access to the air, and it cannot get out; we have shut out the capillary relations. So with fine mulch; we cut off the relations between the small channels in the soil, from which we pump the water out, and the air, and there is a fine coating of dust on top. I think that is the way most of us must depend upon to conserve soil moisture. It is very important to get this mulch back again as soon as we lose it after a little rain, — otherwise half an inch of rain may be a greater damage than if it had remained pleasant.

Humus is important. If Governor Hoard had called my attention to everything I had not said in the paper, it would take a good while longer than the three-quarters of an hour that I wearied you. But I believe that rotation, such as we are using in our State, is fairly good. It is much as the

Governor has suggested. There are many people in our State that are practising the following rotation: the first season potatoes are grown, with commercial or farm manures. The next season they sow some kind of grain, as oats, wheat or barley, with clover. The grain is harvested; and the third season they cut one crop of clover, and in the fall plow under the after-growth, and the rotation is completed and the field is again ready for potatoes.

Governor HOARD. That is, plowed under in the fall?

Professor WOODS. Yes. That is partly because we believe it is a better thing, and partly because spring in Aroostook County has no length. It is winter one day and the next it is summer; we jump from one to the other; and consequently most of the farm work has to be done in the fall. They do not have time to plow in the spring, and they do in the fall; and they get the land in better condition than if they had waited until the spring for their plowing. Whenever they can do it, — they do not often do it, — it ought to be plowed again in the spring.

There has been, by practical growers, more or less of this testing of resistant varieties; but in Aroostook County I think we have grown no varieties that are iron-clad so far as the late blight is concerned. We can keep off the early blight; do not have a great deal, any way. The "Green Mountain" is a resistant variety, very little trouble with early blight; but the late blight can tackle anything, and he does it; and, while there is a difference in susceptibility, I doubt if we are going to be able to depend on hardy variety as a preventive against the late blight; but, as Governor Hoard has said, there is a difference in their susceptibility, and I think, with equally good varieties, of two we ought to choose that one that has proved to be the more resistant.

Prof. WM. P. BROOKS (of Amherst). I want to express my appreciation of the value of the talk Professor Woods has given us, and my agreement with his position. I rise only to emphasize one or two things from our local point of view. One of these points was alluded to by Governor Hoard, — the value of clover sod for potatoes. I agree most

heartily with what has been said in regard to the value of humus. There is another point of importance in connection with this question of clover sod as a crop to precede potatoes, and that is, the question of the extent to which the turning under of clover sod will enable us to manure the crop at the least cost, on account of the fact that clover has a large amount of nitrogen; and evidence of this, of the most striking character, is offered by the result of experiments last season at the college.

We had a field that we divided into eleven plots, of one-tenth of an acre each. Three of these plots have not received, either by farm manure or fertilizer, a supply of nitrogen in any form in probably about fifteen years; but the other eight plots of the field have been manured with something furnishing nitrogen, one field with farmyard manure, two of them with nitrate of soda, three with sulphate of ammonia and two with dried blood. All eleven plots have received a liberal application of materials which furnish phosphoric acid and potash. For the last few years we have been following a general line of experiment, one year to plant the whole field with something that has power to gather nitrogen from the air, and the next year with some other family that does not have power to get nitrogen from the air. We wanted to find out to what extent having a crop that would gather the nitrogen one year would make it possible to have a good crop of some other kind, some other family, the next year, on the plots where we did not use any nitrogenous manure. That has been talked about a great deal, you know, in the last few years. We stuck to soy beans a good many years. We put in soy beans one year, and the next year grain, oats or something of that sort, hoping to see, when we put in the grain, the oats and the soy bean, in these plots that had not had any nitrogen for a good while, that the crops would be coming up approximately equal to those that had been given the nitrogen; but we were disappointed every time. The average crop on the three plots which did not receive the nitrogen kept sinking lower and lower, until, in 1898 I think it was, the average of the three plots which had had no nitrogen

was sixty-five per cent of the average of the other plots in the field, — not much more than half, as you will see. Then we sowed the field with clover in August of 1898, and in 1899 we got two good crops of clover upon the field. We had intended to leave the field in clover another year, but the winter was rather hard on it, and it seemed to be in poor condition in the spring of 1900, so the field was plowed and planted with potatoes; and the crop of potatoes, the average of the three plots that had had no nitrogenous manure or fertilizer in all that time, was almost as good as on any plot in the field. The average was a little over ninety-five per cent, and it was a good crop. Nineteen hundred was not a very good year for potatoes, but our yield was about two hundred bushels of merchantable potatoes, — almost exactly as many on the three plots that had had no nitrogen for about fifteen years.

QUESTION. Did that effect come from the roots?

Professor Brooks. From the roots and the stubble. We got two good crops of clover that year. And here I would express my conviction that, under the conditions existing on most of our farms, it is better for us to vary our practice from that which Professor Woods has spoken of, namely, of plowing under the second crop of clover. I think we get the most advantage when we harvest the second crop as well as the first, and depend on the clover sod. When we do that, I think the value of the stubble and the roots that we reap will be equal to the value of the second crop, if you turn it all in. We have to consider whether this second crop of clover is not worth more to feed than it is to turn in. It has two values: it has a food value, and it has also a manure value; but we can harvest it, under the conditions on most of our farms, and feed it, and derive profit from it as food; and then, if we will save the droppings of our animals and apply them judiciously, we will have saved the manurial value, putting that on our land. Wherever a crop that is fit for fodder stands growing in the field and can be fed, I believe that is the best course to pursue, — to harvest it and feed it, and husband the manure and put that on, and not turn the crop under.

Touching the question of resistant varieties of potatoes, resisting blight, I want to say a word. For the last eight or nine years perhaps, we have had at Amherst, grown under my direction, a good many varieties of potatoes, grown on a small scale, for the purpose of testing their value. Several years we have had as many as eighty sorts, and we have observed them closely, and we have not found a very wide degree of difference in respect to variety when this early blight takes hold of them. We find a difference in the date when the foliage of different varieties is affected, but when grown side by side it is not long before they are all gone, and I do not think there is very wide difference in the amount of damage. There are possibly a few exceptions. We have found a few varieties which were peculiarly susceptible to injury. I should say our experience would prove that there are no varieties which are able to resist it altogether.

On the question of scab and the persistence of the spores or fungus in the ground where you have once had a scabby crop, we have made an observation this year which is of interest: although I would not have you conclude, after hearing it, that it would be perfectly safe for you to go ahead and plant potatoes in ground where you have recently had a scabby crop.

There is on our ground a piece of land notorious for scabby potatoes. Some eight or nine years ago Dr. Goessmann used it again and again in experiments, for the purpose of trying to discover some method for preventing scab. This was when Dr. Humphrey, whom some of you may remember, was at the college, and the experiments were carried out by Dr. Goessmann and Dr. Humphrey together. Later, something like five or six years ago, I should say, speaking from memory, I had the same piece of land used in this experiment, testing the theory which has just been advanced by the State of New Jersey, — that sulphur prevents scab, even in ground where potatoes were ordinarily scabby. We used sulphur without any apparent effect. The potatoes were all scabby, almost all of them, whether we used sulphur or not, and we could not see that there was any particular

difference, not enough to be of practical importance. It occurred to us this year that it would be of interest to plant enough potatoes in that piece of land to see whether these spores were still alive. We did not plant much of it, only a few hills, and the crop was clean, — perfectly clean. Still, as I say, I don't consider that we have proved the point as to how many years scab fungi would live in the ground. But the experiment is an indication that perhaps it is not always quite as long as it has generally been supposed.

Ex-Governor HOARD. Do you think the sulphur took a longer time to produce such an effect? Do you trace it to the sulphur?

Professor BROOKS. I think not. The sulphur was not used all over the plot, and I think the crop this year was not where the sulphur had been used.

Ex-Governor HOARD. What do you ascribe it to?

Professor BROOKS. We don't know what is essential to the vitality of the fungi. We don't believe they will retain their vitality always: they must die in course of time.

Ex-Governor HOARD. I have known of some instances where scabby ground has been treated in Wisconsin, during a very severe drought, by simply plowing the ground repeatedly, plowing it when a cloud of dust would rise, enough to envelop both team and driver, and one instance where it was plowed three times and turned up to the hot sun, and plowed again, where they thought great benefit would accrue from that treatment of the soil.

Professor BROOKS. There has been a feeling in the minds of some that if, during the summer, when the hot-houses are not in use, the soil there could be thoroughly dried, the fungi would be destroyed and the crop of the following winter would be free. It has been tested most thoroughly at Amherst, with results wholly against it. Of course in the houses the soil could be dried very much more than in the open, because it is protected from rain, and it has the hot sun.

Ex-Governor HOARD. Would it have the actinic effect of the sun?

Professor BROOKS. I think so.

Ex-Governor HOARD. The sunlight is very destructive to certain forms of bacteria.

Professor BROOKS. Yes. The house is new, the glass is clean. It is one of the ideas of Dr. Stone that glass must be kept clean. It was perfectly bright and clean; it could not intercept the sun's rays to any extent, so far as I could see; and then, under those extreme conditions, the soil was left for days, weeks and months, and turned over repeatedly, with the intense heat and light of the house upon it, and it was just as bad as where it was not dried in that way.

There is just one other point, if you will pardon me, in regard to what Professor Woods has said about rotation. I would say I think exceedingly well of this rotation of land suited to potatoes, and where cows are kept, silage can be used. Clover sowed to begin with, then potatoes raised on the land, and the land enriched with fertilizer later. The next year corn, well manured, and the land seeded to mixed grass and clover, seeded the latter part of July or first of August. The reason that I prefer to have corn is that a corn crop is of value on the farm. I do not recommend usually two years of corn, but the corn one year, following the potatoes, can be husked, and the next year the corn can go into silage, and then the land is seeded.

Ex-Governor HOARD. Your experience with clover is the same as mine, only I find the difficulty is to get the clover.

Professor BROOKS. You raise an important point there, a point on which there is much need of some light, — how to get clover. Many a farmer who piles the manure on a field of corn or some other crop in heavy quantities, and then sows mixed grass and clover, wonders why he does not get a good catch of clover. I am not surprised in the least. By that treatment he has brought the soil into the best possible condition for grass, and he has therefore rendered it all the more difficult for the clover to get hold.

We have on our place one field where fertilizers on the land have been used in a very peculiar way, — fertilizer on one plot, phosphoric acid and potash on another, on another

nitrate and phosphoric acid, and another nitrate and potash. We have repeatedly, in the course of the last dozen years or a little more, sowed this entire field with mixed grass and clover seed, and have seen the clover come up all over the field, only to die out completely on every part of the field to which potash had not been applied.

EX-GOVERNOR HOARD. Winter-killed?

PROFESSOR BROOKS. No, — starved.

EX-GOVERNOR HOARD. Do you mean to say it died in the winter, or in the summer?

PROFESSOR BROOKS. It died out in the summer. It did not find the right conditions of soil for its growth. To get the most advantage from the growth of clover, you want to enrich the soil with phosphoric acid and potash, lightly, and withhold nitrogen. Farmyard manure is not the best; that makes the grass too strong. On the field I have been talking about, where the phosphoric acid and potash have been used, there is to day a splendid sod of mixed grass and clover, and we usually cut two good crops of hay. There has been no nitrogen applied to that for fourteen years. In 1899, when the field was last in corn, one plot gave a yield of at the rate of sixty bushels of hand-shelled corn to the acre. It has had no nitrogen put upon it, and it gets its nitrogen because of the profuse growth of clover. If you get a growth of clover after your manure, you do not get this advantage I am talking about, because the clover, if it cannot find all the nitrogenous food it needs in the ground, will take it out of the ground. In order to get this great advantage, you must grow it where potash, lime and phosphoric acid are abundant, and where nitrogen is present in relatively small quantities.

We have another field where every year for twelve years we have used two-quarters of the acre manured at the rate of six cords to the acre, and on the other two-quarters we have used half that quantity of manure first and later two-thirds, that is, four cords to the acre, with potash. The field to-day is in grass and clover, and the clover is much stronger on the part on which we put the little manure and the potash. On the other the timothy is stronger and the

clover comparatively scattered. And other crops, manuring it in the same manner, one side six cords to the acre, and on the other half or two-thirds that amount with potash, have been substantially the same order, whether corn or hay; but when it was hay, richer in clover on the part where there was the smaller amount of manure and the potash, — much richer than the other.

Mr. H. A. TURNER (of Norwell). I am very much interested in the matter of growing potatoes. In the town in Plymouth County where I live we have become almost discouraged because of our poor success. We do not know whether it is best to go on and try this crop, or not. I lost one field of potatoes this year by the Colorado beetle. When the potato vines were a few inches high, before we knew it the Colorado beetle was on our farms and had eaten the leaves nearly down to the stem. Consequently the potato plants died, and I lost the whole field.

Professor Woods. We should watch and fight and spray.

Mr. TURNER. Well, I have done the praying but not the spraying. If I understood the lecturer, he said we must not plant the seed too soon after cutting. Isn't there danger of keeping the seed too long after cutting, and drying it too much? I would like to know how long before putting it into the ground it should be cut.

Professor Woods. In our atmospheric conditions, only a few hours. Of course, if it was such a day as to-day, it would not make much difference whether it stood two or three days or a week, for the potato would not dry very fast; but in dry weather I should not want it to be but a few hours after cutting before it is planted.

Mr. GEO. F. BABB (of Amherst). The question of seed is going to be a very important one with me next season. We raise a very fair crop of potatoes on our farm, and, while the majority of them were of good size, there were quite a lot of little ones, and we want to sell all the big ones, from the biggest down to the medium-sized ones. Our method is to plant medium-sized potatoes. I want to know if we cannot save our little ones and plant those next spring, and

hope to get fairly good crops out of them, — enough to make it pay us to sell our medium-sized ones?

Professor Woods. I should not want to plant too small potatoes; and yet I can readily understand that with such a season as we have had this year potatoes are bound to be high, and we will be tempted to practise more economy than we otherwise would. Down in my State, — of course you are not that way in Massachusetts, — if we have two grades of seeds, and one sells for fifteen cents a pound and is of pretty poor quality, and the other sells for twenty and is first rate, our farmers will buy the fifteen-cent one. I would not do it. There will be a good many small potatoes planted, and I do not think in one or two years you will get a very serious result from it; but it is the same way with potatoes as with carnations, — if you take the weakest you will soon have a weak lot of carnations; and so in the propagation of potatoes, if you propagate from very small potatoes you will soon run them out, and, while it might do for this particular year, I should advise you after that to come up into Maine and buy seed for the next year.

Mr. BABB. Wouldn't you want to change the seed there in a few years? I bought Maine seed last year, and it was good.

Professor Woods. We have good conditions under which the potatoes are grown. We can't change our seed much. We haven't got the other fellow further north to buy seed from.

Ex-Governor Hoard. Come and take it from Wisconsin.

Professor Woods. The distance is too great. I think one great trouble with our potatoes is that here the season is long enough so the potato will get thoroughly ripe. In Aroostook County it will not, and you have a potato vigorous for growth, so that if you send to Maine you will probably get better seed than here; but if you plant potatoes here the first of July, so they cannot thoroughly mature, I think you would raise as good seed as we do in Maine.

Mr. BABB. About how small would you recommend to stop in the selection of seed for the coming year, under the existing circumstances?

Professor Woods. Well, I should stop as quick as my conscience would let me.

Ex-Governor Hoard. You spoke about planting potatoes late for seed. Doesn't that raise the proposition whether it would not be better for a person to plant especially for seed?

Professor Woods. I intended to give that impression, and I will say this, that if a man was going to grow his own seed, I think, here in Massachusetts, it would be better to plant a late potato; the only trouble is, a fellow has got a small patch, and he will neglect it. If he plants a few potatoes, there is not one farmer in twenty but what something else would crowd in and he would let it go; and the one great reason we grow better potatoes in Aroostook County than elsewhere in Maine and Massachusetts is that it is the farmer's business to grow his potatoes. He does not keep cows, and he is not obliged to feed his cows or milk them; and there isn't anything he has to do but to take care of that field of potatoes, and that field will have from twenty to fifty acres in it. He keeps one man and a pair of horses working on twenty acres from spring until the fall, and his one man and pair of horses will care for his twenty acres, and they don't do anything else. That is one of the reasons we grow potatoes better, — because we are growing them for business. They are not thinking of the dairy cow or the breed of sheep; I wish they were, but they are not. They are thinking about growing potatoes. When I used to live in Connecticut, up and down this valley there were men that ate, drank and slept tobacco. And so there are men that eat, drink and sleep potatoes down in Aroostook County.

Professor Brooks. I think Professor Woods and I do not differ, really, though I thought so by what he read in his paper. I do not think we can afford to plant seed of our own growing. I have had a chance to observe that a good many times in our own experience; and I have found always, I think, a superior yield in quantity and goodness in seed purchased from Maine. Our own seed is just as good, or perhaps better; but it gives a crop which ripens a little later, and gives a smaller yield. Without intending to discourage those who wish to raise their own seed, from seed purchased

from Maine for planting we finally got seed of our own growing, only to find a falling off of from twenty-five to forty bushels per acre.

Professor Woods. How are your potatoes kept?

Professor Brooks. Kept in a cellar, at a fairly low temperature. It may be our potatoes are all right, and it may well be that if we planted later, especially for seed, we could get as good results as you; but it looks to me as though it was quite doubtful whether it would pay. It seems as though it may generally be better for us to take our seed from Maine. I believe the greater cost of the seed is much more than paid for by the superior value of the crop, both because we have more, and because it is a little earlier, which is of considerable value to us here.

Ex-Governor Hoard. I think there is a great deal in this question of the transfer of seed. Around Greeley, Colorado, is one of the greatest potato-growing sections of the United States. They grow enormous quantities of them, and they find there it is very much to their benefit to send up into what is known as the potato section of the sandy belt of Wisconsin for seed, and carloads of potatoes go into Colorado from Wisconsin for seed alone.

Professor Woods. Several of the experiment stations in the country, in co-operation with the United States Department of Agriculture, are considering the effect of climate on the potato. I would like to say that in Virginia they have been experimenting with home-grown seed, especially planted for seed; and I think when we get short in Maine we could very well go down to Virginia and buy seed, because they are getting so much better results from the home-grown seed there, growing it for seed and taking care of it. I am of the opinion that proper growth and care of the seed are of greater importance than latitude.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock, by First Vice-President Sessions, who said: The lecture this afternoon is of peculiar interest in many ways. The title of it is confined to the shade-tree problem, one of the greatest problems

that the agriculturist has to meet to-day ; but the truths in regard to the insects which ravage the shade trees can be largely applied to the treatment of those that prey upon other vegetable products. Those of you who were here this morning will remember what the speaker said about the damage to the potato crop by insects. Now, you can, if you care to, question the lecturer this afternoon, if there is time, and get many a point and hint to help you in your combat with various kinds of insects. The speaker is a man who has made the study of entomology his business in life, and he has not only studied it, but for several years he has been connected with what is now called the “ gypsy moth committee.” You have not heard the last of the gypsy moth. One of these days, and not many days hence, you will hear considerably more.

I have the pleasure of introducing to you A. H. Kirkland, a graduate of the Agricultural College, who has made a study of this insect problem, and he will now address you on “ The shade-tree insect problem.”

THE SHADE-TREE INSECT PROBLEM.

BY A. H. KIRKLAND, M.S., BOSTON, MASS.

The love of nature common to man never finds worthier expression than in the planting of shade trees. We plant orchards that our financial resources may be increased; we plant shade trees primarily that our environment may be adorned and our inner lives enriched. The limitations of circumstances may restrict our planting to a few specimens of some favorite variety; or it may be our good fortune to have a part in beautifying streets and public places with trees that will contribute to the enjoyment of thousands to us unknown. In either case we pay homage to nature as manifested under one of her most pleasing forms. What a tribute to the good taste and good sense of past generations are the magnificent elms that adorn the valley of the Connecticut. These monarchs of the meadow are all around us. Had they voices, what tales could they relate of generations and events whose records have long since passed into history. Beside their ripened age the span of human life seems as but a watch in the night. We approach them with admiration that is akin to reverence. Here they have contemplated the passing centuries; here they have witnessed the development of a great nation; and here they still stand, eloquent though silent witnesses of the forefathers' love for the beautiful and thoughtfulness toward posterity.

And perhaps it is well for our peace of mind that audible speech has been denied our grand old trees. Had they voices, no doubt they would cry out at the injuries and wanton neglect too often falling to their lot. Their roots, anchored deep in the earth, are severed to make way for curbs or water mains; their Heaven-seeking tops are butchered to give clear passage to electric wires; and, what

is more common, their foliage is denuded and their vitality sapped by hosts of hungry insects whose ravages might be prevented with a minimum amount of intelligent effort on the part of man.

So general is this latter form of injury that tree lovers are being continually brought to face what may be well named "The shade-tree insect problem." The damage may be slight, and confined to a single valued tree; or it may be great, and seriously affect the shade trees of an entire community. Under one guise or another the problem recurs with the seasons and apparently in increasing magnitude. It is indeed a problem that may well receive the earnest consideration of this Board, — a body which for half a century has actively and consistently encouraged every effort making for the better preservation of fruit and shade trees.

That damage by insects is increasing seems to be an accepted generalization. Things were not thus in "the good old days," if we are to believe commonly circulated statements. Admitting frankly that insect damage is now of more importance than formerly, I would suggest that, in contrasting present with past conditions, due allowance be made for the infirmities of memory and the deficiencies in records. Accounts of insect depredations in the early years of civilization, while relatively scarce, show that injury by these pests has been contemporaneous with the development of agriculture.

Considering the slight attention given to natural history in early literature, the sacred writings contain many interesting references to insect damage. Of the plagues of Egypt, three were of an entomological nature, — lice, flies and locusts; while the lament of the prophet Joel, "That which the palmerworm hath left hath the locust eaten; and that which the locust hath left hath the cankerworm eaten; and that which the cankerworm hath left hath the caterpillar eaten," may well strike a responsive chord in the hearts of agriculturists of the present day.

Three hundred years before Christ, Aristotle described several noxious insects; while Pliny, writing about 77 A.D., has given lengthy details of insect damage. Theological

writings of the middle ages describe several church trials of the insect pests of that day. Such proceedings were of a most serious and formal nature. The pests were haled (by proxy) before the bar of the church, and, after being found guilty, were subjected to anathemas and maledictions. We may say parenthetically at this point that this unique method of dealing with insect pests has been described at length by M. Laverune in "*Cosmos*," of Sept. 12, 1897; and that in the year of grace 1899 an attempt was made to check the forest tent caterpillar invasion at St. Hilaire, P. Q., by similar means. Later newspaper reports indicate that the use of Paris green finally proved a more effective remedy.

The historic outbreak of the brown-tail moth at Grenoble in 1543 is one of the best authenticated instances of widespread damage from caterpillars.

The Puritan settlers of Massachusetts early found their attempts at agriculture hindered by the attacks of native insects, and gravely recorded the seasons of 1646 and 1649 as "caterpillar years."

Scarcely a century ago damage by the canker worm in Boston and vicinity led the Massachusetts Society for Promoting Agriculture to offer a substantial reward for the best treatise on the insect, and means for preventing its ravages.

Between 1860 and 1880 damage by the gypsy moth in the forests of central and southern Russia reached a severity hardly paralleled by any insect depredations previously recorded.

I have given some space to the mention of these historical insect depredations, to emphasize the point that in all lands and at all times noxious insects have vexed the labors of the tiller of the soil, and that the present is not an unusual period, so far as damage by insects is concerned. Compared with past standards, however, it is an unusual period in the increased attention given to the care of trees. Never before have so many people been interested in the cultivation of trees; never before have greater efforts been made to disseminate information concerning their proper treatment. The care of public shade trees is being made generally a public duty throughout the land. The tree warden

act in this State is an encouraging sign of the times, showing the drift of popular sentiment. The enhanced value now placed upon shade trees leads naturally to an increased appreciation of the damage wrought by shade-tree insects, — an interest bound to grow with the increasing concentration of population in cities and their suburbs.

Of three principal factors directly favoring an increase in insect depredations of shade trees, one of the most important is the massing throughout large areas of a single species of tree, in accordance with the modern dictum “that every connected street must be planted with a single variety of tree.” Insects are more or less critical in matters of diet, the tent caterpillar preferring the wild cherry, the elm-beetle the various species of elm, the brown-tail moth the pear, and so on throughout the list. Where the chosen food plant of a particular insect has been planted in large numbers, there that species finds just the best conditions for its rapid development. The “City of Elms” must be of necessity the city of elm insects. Boston Common gives a more familiar illustration. The older plantings are almost entirely of the American and English elms. The white-marked tussock moth finds in the foliage of the elm food exactly suited to its development: hence this insect has periodically stripped these elms at least from the days of Harris to the present time, its ravages being ultimately checked by the increase of its parasites.

Another factor which has contributed in no small degree to recent outbreaks of shade-tree insects is the superabundance of the English sparrow, a seed-eating bird, pugnacious, filthy in habit, and of but little practical value as a destroyer of insects. This bird thrives best where population is most dense, and this is just the condition under which shade trees have the hardest struggle for life. Immensely prolific, and finding an abundant food supply in the form of offal and refuse, the sparrow has directly or indirectly eliminated the native birds which formerly inhabited our city trees and fed upon injurious insects. We need not seek far to find an illustration of the harm wrought by this bird. In Northampton and vicinity the sparrow has largely

driven out the native birds. In the farming communities just outside this city damage by the canker worm is now of frequent occurrence. The hilltops to the west, Chesterfield, Huntington and Blandford, for example, are not yet occupied by the sparrow. There cuckoos, orioles and warblers nest undisturbed, and there the chickadee, nuthatch and woodpecker ply their trade throughout the year. Although the canker worm breeds in these localities, it is seldom able to develop in numbers sufficient to commit serious harm. Damage by the sparrow along this line is particularly noticeable in the case of insects which are general feeders. Special feeders, insects like the elm-leaf beetle, limited to one or a few food plants, cannot spread beyond a certain area without exhausting their local food supply: thus they are subject to limitations which eventually confine their activities. On the other hand, general feeders, like the gypsy moth, forest tent caterpillar and web worm, are not restricted to a single or even a few food plants; hence in their cases man stands in even greater need of the help given by birds and parasites. Add to this the fact that these general feeders are usually hairy, and that hairy caterpillars are seldom eaten by the sparrow, and the damage caused by this bird is seen to be greater than would at first appear.

So far as Massachusetts is concerned, the greatest damage to shade trees by insects in recent years has been caused by certain imported pests. These insects, accidentally brought to our shores, usually arrive unattended by the parasites which hold them in check in their native environment. Finding America a land of freedom indeed, they commit depredations by the side of which their ravages in the Old World frequently pale into insignificance.

Perhaps as good an illustration as any of this point is found in the case of the San José scale (*Aspidiotus perniciosus*), which, primarily a fruit-tree insect, is becoming a dangerous enemy of shade trees in many localities. Introduced into California in the early seventies, it has spread into nearly every State if not every one in the Union, killing nursery stock, fruit trees and even shade trees of good size. Probably no more deadly orchard insect ever found

its way to our shores; yet so comparatively harmless was it in its native environment that we have but just learned authoritatively that it hails from northern China. Beyond doubt its increase at home is restricted by certain parasites, and when it was imported to the United States the importation did not include the beneficial agents.

Of these imported pests, the one at present of the greatest general importance in Massachusetts is the European elm-leaf beetle (*Galerucella luteola*, Muell.). This insect has

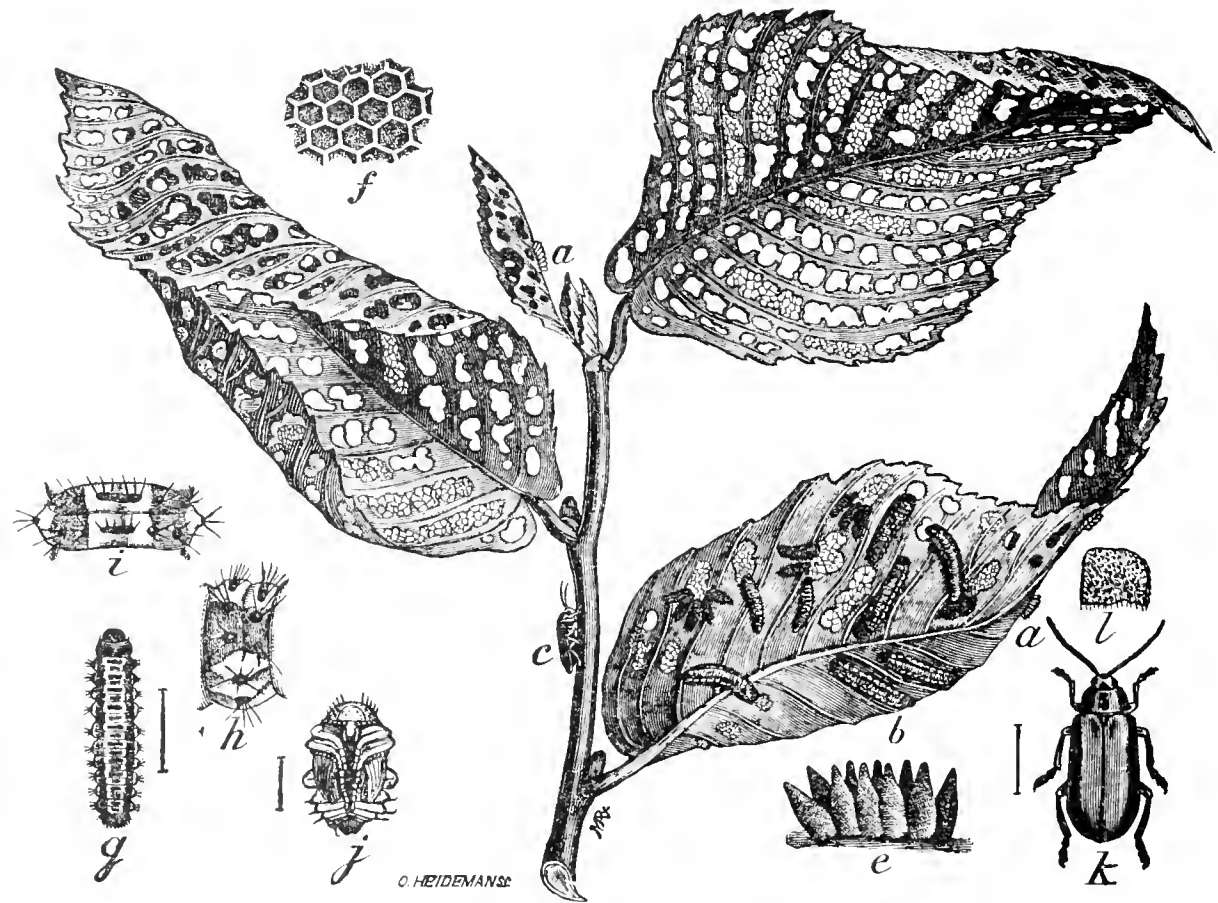


FIG. 1. Different stages of the elm-leaf beetle: *a*, eggs; *b*, larvae; *c*, adult; *e*, eggs enlarged; *f*, sculpture of eggs; *g*, larva enlarged; *h*, side view of greatly enlarged segment of larva; *i*, dorsal view of same; *j*, pupa enlarged; *k*, beetle enlarged; *l*, portion of wing-cover of beetle greatly enlarged. — From Riley, Report United States Department of Agriculture, 1883.

now established itself in nearly all our cities and larger towns. It has been characteristic of the northward spread of the beetle that its routes of march have been particularly along water courses and the seaboard. One reason for this readily suggests itself. These well-watered localities are the ones in which the elm most freely develops. It divides

honors with the willows and poplars as the characteristic tree of our river valleys and seaboard. This abundance of elms along our streams long ago defined the areas in which the beetle can breed to the best advantage, and where it will doubtless become a permanent resident. The swarms of beetles which invaded this State from the south by way of the Housatonic and Connecticut valleys have passed northerly into southern Vermont and New Hampshire, while lateral swarms have ascended the valleys of the Westfield, Deerfield and Ware rivers. Another invasion of a later date has occurred along the line of the Blackstone River. The beetle has also worked eastward around the coast and up the Merrimac River to Haverhill, Lawrence and Lowell. The main lines of railroads probably have contributed in no small degree to the diffusion of the beetle, which with the approach of cold weather frequently enters freight cars for the purpose of hibernation. Finally, the compact plantings of elms in the centres of our towns and cities have given the insect the best kind of an opportunity to develop as a local pest.

The life history of this insect is similar to that of other members of the great family Chrysomelidæ. The beetles hibernate in large numbers in sheltered localities, under roofs, shingles, clapboards and in empty buildings. As soon as the warm weather starts the buds of the elm, these beetles emerge and feed greedily upon the young leaves, which soon become perforated as if by charges of fine shot. After feeding for a week or ten days, egg-laying is commenced, and by this time the leaves are nearly developed. The beetle feeds and lays alternately over a period of several weeks. Two female beetles observed by Dr. E. P. Felt for four weeks laid respectively 431 and 623 eggs. Because of the similarity, any one familiar with the eggs of the potato beetle will readily recognize those of the insect under discussion. The yellow, spindle-shaped eggs of the elm-leaf beetle are laid in small compact masses on the under surface of the leaf. In a week's time the eggs hatch and the young larvæ commence feeding upon the tender foliage.

While the damage caused by the feeding of the mature

beetle is of considerable importance, it is not to be compared with the injury wrought by the larvæ. These insects destroy the epidermis, feeding upon the under sides of the leaves. The latter turn brown and soon fall from the tree, sometimes leaving it as bare as in midwinter. When the larvæ are full grown they are about one-half an inch in length, light yellow in color, with black markings arranged along the back to form two conspicuous stripes. The mature larvæ drop in large numbers from the tips of the overhanging branches, and pupate in masses in or near sheltered places. A small per cent pupate beneath the bark of the tree, or descend to its base. From these orange-colored pupæ in from five to ten days mature beetles emerge and feed upon the foliage.

There are two well-defined broods of the insect at Providence and on Cape Cod, and a partial second brood certainly occurs at Springfield. The effect of the repeated defoliation is to sap the vitality of the trees and invite the attacks of other injurious insects, notably bark beetles and borers, and the death of the tree is often the ultimate result.

While the spraying of the foliage is a difficult and often an expensive undertaking, it offers the most effective means of combating this insect. The insecticide used should be some form of arsenate of lead, and, if possible, should be thoroughly applied in the spring, when the beetles are feeding. It is obvious that, if the hungry hibernating beetles can be destroyed, further damage by the insect will be prevented. The general custom, however, is to wait until the foliage has fully developed, and then treat it with a heavy spraying of arsenate of lead. This will destroy the late-feeding beetles, and will remain in an effective condition until after the eggs have hatched and the larvæ have commenced to feed. One thorough spraying should preserve the trees from injury throughout the season, although in the case of the second brood it is sometimes necessary to make an additional spraying late in July or early in August.

Since Massachusetts abandoned the work of exterminating the gypsy moth (*Porthetria dispar*, Linn.), the numbers of this insect have increased to an alarming degree in the east-



Elm at Boston defoliated by larvæ of elm leaf beetle.

ern part of the State, and we must now prepare for the time when it will become generally diffused throughout this and adjoining States. For two years it has had an opportunity to multiply unrestricted, and the developments of last summer would lead us to anticipate a repetition of the outbreak of 1888-89 in the near future. Already in many localities in the metropolitan district formidable colonies of the moth have seriously menaced park and shade trees. The Fells reservation of the metropolitan park system is badly infested, and most strenuous efforts will be needed in the near future, if one of our most beautiful park areas is to be preserved intact for the enjoyment of our citizens.

The parent moth lays its eggs to the number of five hundred to one thousand, in a yellow, hairy covered mass, on tree trunks, fences, buildings, walls, etc. The eggs hatch early the following May, and the caterpillars swarm abroad in search of food. They devour both buds and leaves, and sometimes even attack the tender bark of the twigs. As soon as the foliage develops they give it their undivided attention, feeding chiefly by day. When about one-

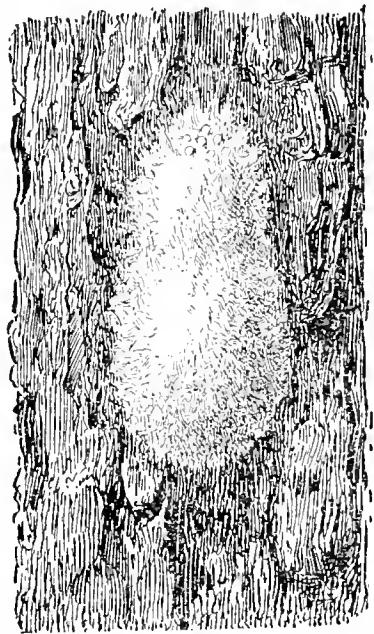


FIG. 2. Egg cluster of gypsy moth.

third grown their feeding habits change, and the insects seek shelter by day and feed almost entirely by night. The full-grown caterpillar is sparingly covered with stout hairs, and has a double row of tubercles along the back. On the five anterior segments these tubercles are blue: on the six posterior, dark red.

The caterpillars pupate in masses in any convenient sheltered locality, particularly at the bases of large branches, and in about a fortnight the moths emerge. The males are yellowish brown, expand about one inch, and fly actively on warm days. The females are somewhat larger than the males, white, sparingly marked with black, and, although

provided with well-developed wings, do not fly. After mating, the females at once deposit their eggs, the life cycle of the insect usually being completed by the middle of August. As the egg masses are usually laid near the ground, and are conspicuous for some eight or nine months, it is obvious that this season is an excellent time to combat the insect. The spongy egg masses should be saturated with a mixture of creosote oil, containing 15 per cent coal tar incorporated by the aid of heat. The addition of the tar is not necessary for the destruction of the eggs, but is desirable

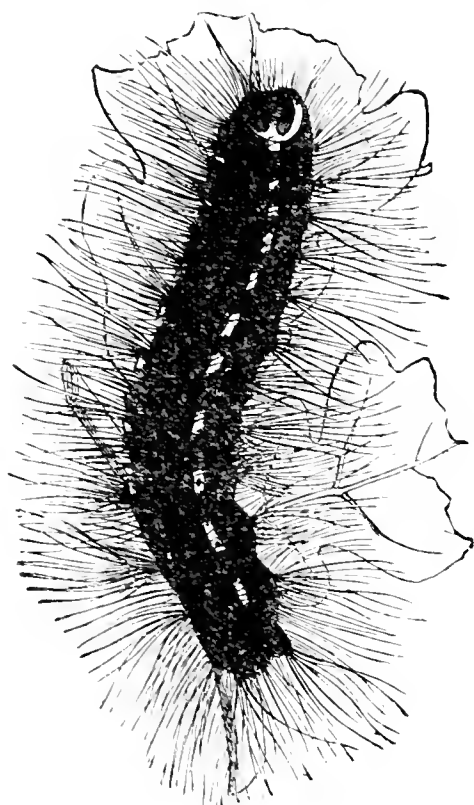


FIG. 3. Full-grown caterpillar of gypsy moth.

in order to color the treated nests, thereby distinguishing them from those untreated. In extremely cold weather the mixture thickens, and should be thinned by the addition of turpentine or benzine.

Where this work of egg destruction has been neglected, and the caterpillars allowed to hatch, chief reliance should be laid upon a thorough spraying of the foliage with arsenate of lead as soon as it develops. Advantage should also be taken of the habit of the caterpillars in seeking shelter, by tying bands of burlap loosely about the trunks of the infested trees at a convenient height. These bands should be examined every day, and the caterpillars concealed beneath them destroyed.

The chief characteristics of the gypsy moth which make it so serious a pest are its wide range of food plants, feeding, as it does, on all deciduous trees and nearly all conifers; its relative immunity from attacks by parasites; and its insidious night attacks, whereby entire trees are often defoliated before the presence of the insect in force is suspected.

In the attempt to exterminate the gypsy moth the State



Pines, oaks and other trees stripped by the omnivorous caterpillars of the gypsy moth. Georgetown, July 11, 1899.

of Massachusetts has given the world one of the greatest object lessons in applied entomology. The abandonment of the work by action of the Legislature at a time when the insect was well suppressed has seemed to many a great mistake. Present indications are pointing in no uncertain way to the ultimate justification of the State work against the moth as conducted by a committee of this Board. The truth will ultimately be established, and we must wait with patience the developments of the near future.

It is fortunate that from this great undertaking there have developed improved methods of combating insects, which have a wide application. Thus the original use of arsenate of lead as an insecticide against the gypsy moth has now been extended to the treatment of the elm-leaf beetle and a host of other leaf-eating insects. The improvements in spraying apparatus developed in the gypsy moth work have a world-wide usefulness, and already this improved apparatus is now in general use in park work in the larger cities of New England.

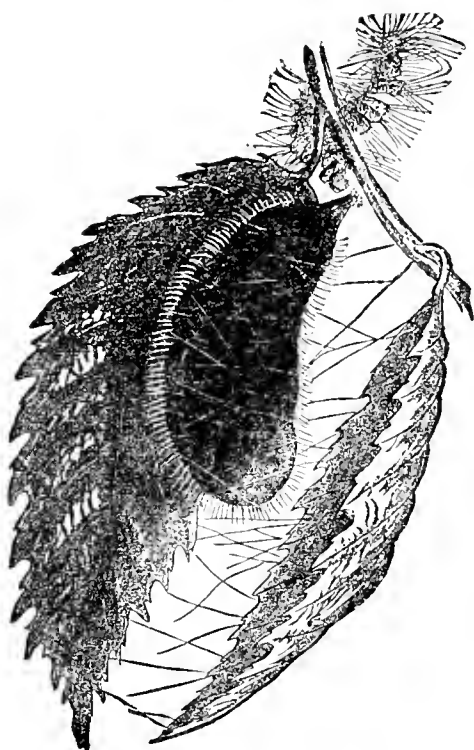


FIG. 4. Pupa of gypsy moth.

The past summer has brought to light a large colony of the gypsy moth at Providence, R. I. From all evidence at hand, it is apparent that the insect was taken to this city by some malicious person, and it is quite possible that other similar colonies may be found elsewhere. In view of this fact, it seems probable that the gypsy moth will now never be exterminated in New England. Property owners in the vicinity of the infested sections should carefully familiarize themselves with the appearance of the various forms of the moth, in order that incipient infestations may be dealt with in season. Should official work against this insect be renewed, it would seem desirable to

carefully investigate the parasites preying upon this insect in its native home, although such work was hardly feasible while the State was engaged in the effort to absolutely exterminate the moth, as the presence of imported parasites

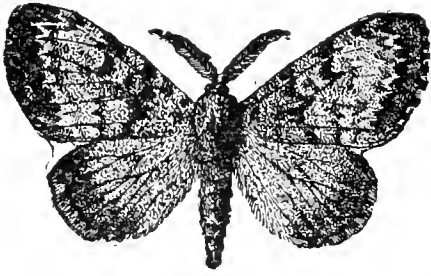


FIG. 5. Male gypsy moth.

would necessitate the presence of an abundant supply of the host insects.

Another European insect responsible for a notable amount of damage and annoyance in eastern Massachusetts is the rapidly spreading brown-tail moth (*Euproctis chrysorrhoea*, Linn.). This pest first came into prominence in May, 1897, when it was found committing severe depredations on pear trees at Somerville. It seems probable that the insect was brought to this locality on rose bushes imported from Holland or France.

This insect has a unique life history, in that its caterpillars successfully hibernate in a half grown condition in conspicuous webs at the ends of the infested twigs. Leaving these webs as soon as the buds swell in the spring, the tiny caterpillars first consume the buds and later devastate the foliage. By the last of June they have reached their full development, and spin up in loose cocoons on the smaller

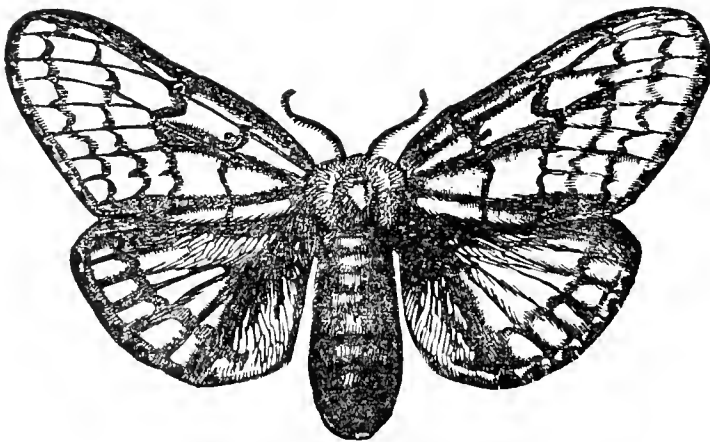


FIG. 6. Female gypsy moth.

branches, on houses, walls and in other sheltered localities. From these cocoons in about three weeks' time the white, brown-tailed moths emerge and fly vigorously by night in search of suitable places in which to deposit their eggs.

PLATE I.



FIG. 1.



FIG. 2.



FIG. 3.

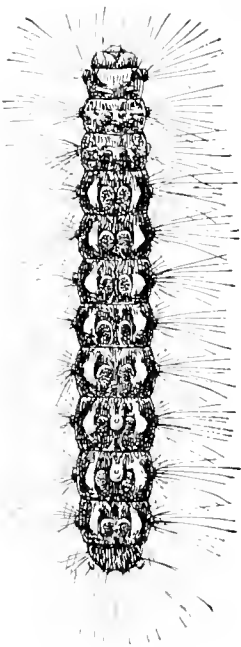


FIG. 4.

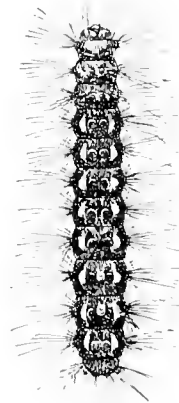


FIG. 5.

Explanation of Plate I.

FIGURES NOS. 1, 2, 4 AND 5 DRAWN FROM NATURE BY J. H. EMERTON.

No. 1. — Female brown-tail moth.

No. 2. — Winter web of brown-tail moth caterpillars.

No. 3. — Pruning shears suitable for removal of winter webs.

No. 4. — Brown-tail moth caterpillars, enlarged.

No. 5. — Brown-tail moth caterpillars, natural size.



Pear tree defoliated by the caterpillars of the brown-tail moth. The webs on the trees in the back-ground were destroyed during the

These insects are strongly attracted to light, and great numbers of them meet their fate in the globes of arc lamps. This same attraction to light, however, has doubtless been the means of spreading the moths from town to town, since it is found that the oldest infestations are found in the centres of towns where the lights are most numerous. The eggs are laid in compact, hair-covered masses, on the under surface of pear and other leaves, and hatch in about three weeks from the date of laying. From 200 to 400 eggs are deposited by each female moth, the rate of increase being somewhat slower than is the case with the gypsy moth. The menu of the brown-tail moth includes a wide range of ornamental trees, although primarily it must be considered to be a pest of the pear tree. Wherever it is numerous, maples, willows and elms are defoliated to a serious extent.

For two years this insect was suppressed by the gypsy moth committee, but with the abandonment of the work of that committee in the spring of 1900 the systematic campaign against the brown-tail moth necessarily came to an end. It has been interesting to the writer, living since that date in the infested district, to note the gradual increase and spread of this pest in the vicinity of Boston. Where in the winter of 1899-1900 there were but scattered webs, they may be counted now by the thousand.

Not the least important feature of outbreaks of the brown-tail moth is the truly terrible irritation caused by the hairs of the caterpillar whenever they come in contact with human flesh. This irritation is well compared to nettling several degrees intensified, and probably is of a mechanical nature, being produced by the fine, brittle, barbed hairs breaking up in the skin. It is best allayed by the liberal use of vaseline or sweet oil. Last summer so severe and general was this painful affliction in the Allston and Brighton districts of Boston that the residents of those suburbs petitioned for and received a public hearing at the office of the Boston Board of Health. The nettling of these caterpillars furnishes an excellent but painful means of identifying the insect.

The brown-tail moth is now known to occur in a territory

bounded by Scituate, Brockton, Hudson, Lowell, and Seabrook, N. H. An isolated colony also occurs at Kittery, Me. As the female moths fly vigorously, this insect spreads much more rapidly than the gypsy moth, and it seems probable that within a short term of years it may occur throughout the entire State of Massachusetts.

It is fortunate that the insect is exposed in conspicuous webs throughout the winter, thus making its destruction easy. For the work of cutting off the webs the common form of pruning shears attached to a pole is the most convenient implement. The webs so collected should be carefully burned at once. Where this work is thoroughly done, there will be no damage by the brown-tail moth the succeeding year. It is remarkable how quickly and at what small expense these webs may be collected and destroyed by trained men, suitably equipped. In the winter of 1899 the employees of the gypsy moth committee gathered and destroyed over 900,000 webs, at a total cost of \$9,700.

This work of web destruction is the cheapest and most effective method of disposing of the pest; but if it is neglected until after the caterpillars leave the web in the spring, the infested trees should be thoroughly sprayed with arsenate of lead. It is also necessary sometimes to spray, to protect the trees from the fall brood. This spraying should be done in September, as soon as the small webs are noticed. In the case of pear and other fruit trees this late treatment will result in the poisoning of fruit approaching maturity. However, it is but a choice between two evils, since, if the tree is defoliated, the fruit will fall before it is ripe. On shade trees there is no valid objection to the fall spraying.

Turning to our native insects, an important periodic pest of shade trees is the tussock moth (*Orgyia leucostigma*, S. and A.). This insect is well known in Boston, Providence and elsewhere, from its severe injuries to elms in certain years. While primarily an elm insect, when numerous it attacks in force the linden, horse chestnut, silver maple, pear and other trees. Its damage is contemporaneous with that of the elm-beetle, and, as it is double-brooded, at least in our river valleys and along the seaboard, it is a shade-tree

pest of no mean rank. Fortunately, however, its increase is largely controlled by parasites, which, when the caterpillars are numerous, soon gain the ascendancy. This accounts for the occurrence of the insect in force only at somewhat extended intervals.

The white, froth-covered eggs of this insect are common objects on the trunks of trees chosen as food plants.

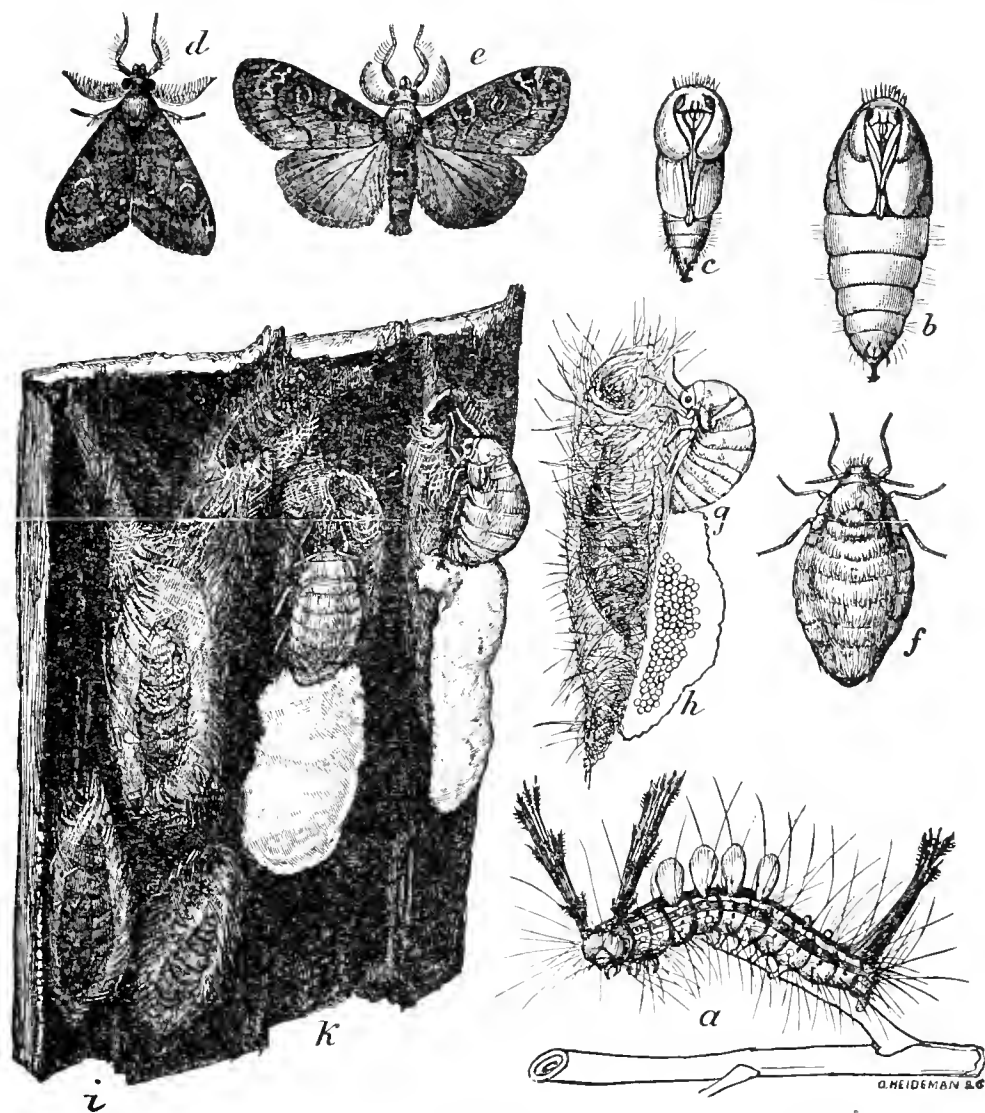


FIG. 7. Different stages of the tussock moth: *a*, caterpillar; *b*, female pupa; *c*, male pupa; *d*, male moth; *e*, same, wings spread; *f*, female moth; *g*, female moth on cocoon; *h*, egg mass with froth over it; *i*, cocoons on tree trunk; *k*, same, showing females and egg masses also; all slightly enlarged. — From Howard, Yearbook, United States Department of Agriculture, 1895.

The egg masses are laid by the wingless female moths, — mere spider-like creatures, — in late summer or fall, on the old cocoons, and are covered with a brittle white varnish. The number of eggs laid by a single female ranges from 75

to 200, the species being perhaps the least prolific of any we have discussed. The young larvæ leave the egg masses late in the spring, after the leaves have developed, feed freely on the foliage, and attain maturity by mid-summer. Their characteristic markings are two plumes of hair directed forward on either side of the head and a similar plume pointing backward from the posterior end of the body, together with a row of short, dense brushes down the upper surface of the body. The caterpillars drop freely from the branches when disturbed, and are carried from place to place by teams and pedestrians. When full grown the larvæ spin up in loose, yellow cocoons on the trunks of trees, along fences and in other suitable sheltered places. In two weeks the moths emerge and deposit eggs for a second brood, which is frequently more injurious than the first brood. The moths from this last brood continue to appear until freezing weather sets in. Thus at Somerville, Mass., November 2 of the present year, the writer found belated female moths of this species still engaged in the work of egg laying.

This insect is controlled easily by spraying with arsenical poisons or by the destruction of the egg masses in the fall, winter and spring. Crude creosote oil, uncolored, gives perhaps the best means of killing the eggs. It should be applied by means of a sponge or brush, as in the case of the gypsy moth egg clusters. Where an invasion of the tussock moth has commenced, non-infested trees may be kept free from the swarming caterpillars by the use of stocky bands of raupenleim, bodlime, tar, tree ink, or even cotton batting. On small trees the caterpillars may be jarred off, and the trees banded to prevent reinfestation. The destruction of the cocoons before the moths have emerged is not advised, because of the large numbers of beneficial parasites that breed therein.

The fall web worm (*Hyphantria cunea*, Dr.) probably is one of the most general feeders of our insect fauna. Appearing in late summer, it spins its unsightly webs on the tips of branches of almost every kind of a fruit or deciduous shade tree, at once distinguishing itself from the tent caterpillar, with which it is commonly confounded. The latter



Elms at Boston defoliated by caterpillars of Tussock moth, 1895.

insect appears only in the spring, and always places its webs in the forks of the branches. The butternut, ash, oak and elm have to pay tribute to the web worm, while the maples, lindens and horse chestnuts are almost equal sufferers. A ride through the State in August or September will show that the pest has little preference in the matter of localities or food plants. The fact that it appears so late in the summer is of advantage to the trees, since at that season the effect of defoliation is not as injurious as when it occurs at an earlier date; still, the webs are unsightly, the insect annoying, and the injury to the tree of sufficient importance to

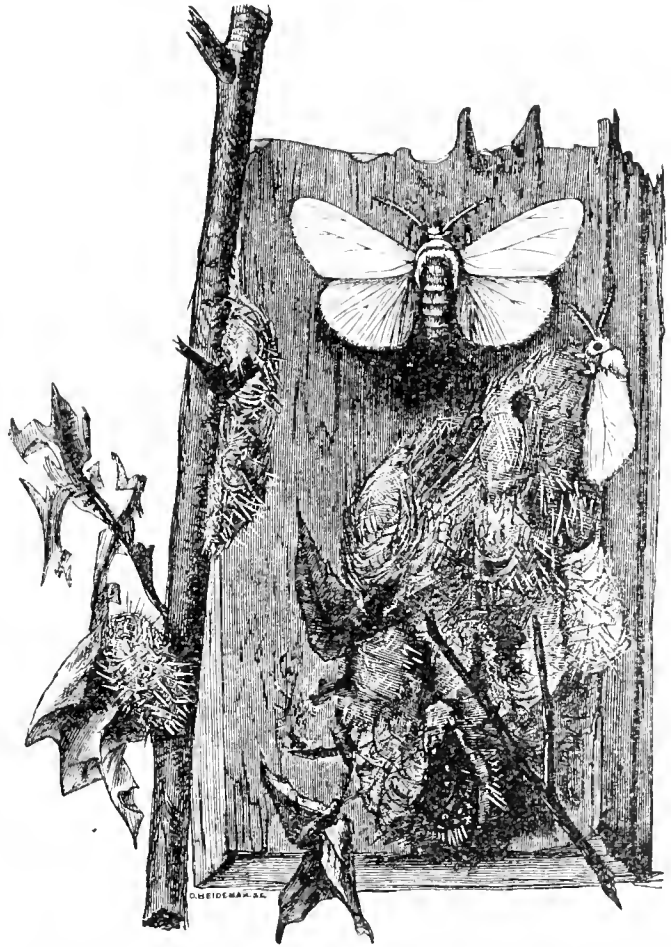


FIG. 8. Fall web worm, moths and cocoons, natural size. — From Howard, Yearbook, United States Department of Agriculture, 1895.

necessitate remedial measures. Farther south, where the insect is double-brooded, its ravages have an increased importance.

In this State the moths emerge from their cocoons in July, and lay upwards of 400 eggs in a cluster on the under surface of the leaves. The young larvæ at once begin spinning a web, which includes the near-by foliage, and often extends by the close of the feeding season over an entire branch. These webs doubtless serve as some protection from parasites, although on the other hand, they are the best kind of sign-boards for the guidance of cuckoos, orioles and other birds that consume hairy caterpillars. When full

grown the caterpillars are one and one-half to two inches in length, with yellowish, longitudinal markings, and clothed with grayish hairs. They wander about on walks and fences in search of places to pupate, and in this latitude often find shelter beneath loose rubbish on the surface of the ground; otherwise, the cocoons are placed at the base of the tree or on fences near the ground. Pupation takes place in September, and the white moths do not emerge until the following July. As already pointed out, the web worm is extensively preyed upon by birds. It is also parasitized by various ichneumon flies. In eastern Massachusetts it is often confounded with the brown-tail moth, whose webs, however, are much smaller and more compact, and whose caterpillars feed outside of the web, returning to it for shelter only.

A common practice among farmers is to burn the webs by means of a torch. If this is done as soon as the insects appear, no strong objection can be raised against the practice, as the large branches will not be injured, as is often the case where tent caterpillar webs are burned in this way. A better practice is to spray thoroughly with arsenate of lead as soon as the first webs are noticed. The poisoned foliage will be drawn into the web, and the caterpillars destroyed.

And right here we may well emphasize a unique property of arsenate of lead. This insecticide adheres in a notable degree to the foliage, and trees that have been thoroughly and heavily sprayed with it in the spring will be exempt from damage by the web worm in the fall.

Some years ago the writer sprayed part of a row of pear trees, about May 15, to destroy the brown-tail moth. Various strengths of arsenate of lead were used, and it was found that trees sprayed with this insecticide at the rate of 3 or more pounds to 100 gallons of water were completely exempt from damage by the web worm the following August. Lower proportions of the poison did not give satisfactory results, while the trees in the row that were not sprayed were badly injured by the web worm. As the trees sprayed were in the middle of the row, the result of the treatment was unmistakable.

Willows and poplars are much in demand in planting schemes for damp localities, or in places where rapid growth is desired. As trees of this class are so well adapted for such purposes, it is most unfortunate that they are becoming more and more subject to damage by the imported willow weevil (*Cryptorhynchus lapathi*, Linn.). This small snout beetle of the great family of weevils has been known for generations in Europe as a pest of the basket willow and of alder plantations. Its food plants there include about all the willows, poplars, many alders and a few birches. It occurs from southern France up into the highest mountains of Switzerland, where it breeds in the green alder. Doubtless it was brought to this country in nursery stock; certainly its general occurrence in the nurseries in this State would give force to this opinion. It has now spread at least from Brooklyn to Portland and westward to Buffalo and points in Ohio.

The mature beetle is of a dark-brown color, with a conspicuous white marking at the posterior part of the body, and with smaller white markings on the anterior part of the wing covers. With its long snout it drills holes into the bark just beneath the leaf scars, and inserts its eggs, from one to four in a place, each in a separate chamber, which is afterwards closed with bark dust. This egg laying, as the writer has observed it, takes place late in the summer; but in nearly every case the eggs hatch and the larvæ feed in the bark for a few weeks before hibernating. The insects at this time are so minute in size that they can be found only by diligent search. With the coming of spring, however, they extend their burrows in the bark, breaking through the surface at frequent intervals, and then in about a fortnight sink into the sapwood and finally to the heart of the tree. The growth of the white, yellow-headed larva is something phenomenal, especially in young trees. By the first week in July the larvæ are fully grown, and carefully enlarge their burrows downward to the surface of the bark, throwing out large quantities of white chips, which are an excellent indication of the presence of the insect. The sap which oozes from the burrows is also a characteristic sign of the

insect's work. Having drilled its burrow to a uniform diameter, the insect ascends to the upper end, packs itself securely in an elliptical chamber, and pupates. In 1897 the writer collected a large number of infested sticks of poplar, and examined them daily from June 30 to July 31. In a single stick, one and one-half inches in diameter and two feet long, he found 57 larvæ. Some of these sticks were split open each day, and on July 3 and 4 about all the larvæ were found to have pupated. By July 22, mature beetles were found in the wood, although emerging did not take place until about July 31. This would give us about eighteen days as the length of the pupal stage.

The beetles appear all through the months of August and September, and, after feeding for some weeks upon the tender petioles, deposit eggs for the brood of the following season. In young, rapidly growing trees, with an abundance of tender wood, the development of the insect is as detailed: in older trees a part of the beetles do not emerge until the second spring. This gives us the straggling imagoes that have so confused students of the life history of this insect.

This pest is not amenable to treatment by spraying, so far as at present known. The best method of treating it is to dig out the young borers in the early spring, when they are still at work in the bark, where their black burrows can be detected by careful observation.

Trees infested with this insect are weakened, and are easily broken down by ice storms. This insect gives us another illustration of the folly of planting only a single variety of shade tree. The silver maple, the three-thorned acacia and the elm make good growth in localities where poplars and willows are most grown for shade or ornament, and are not subject to attack by this weevil.

It is difficult, in a paper of this kind, to select those insects that are most injurious without excluding species of at least considerable local importance. Should all important shade-tree insects of the State be considered fully, the next winter meeting of the Board would find us not far removed from the meadow city. The writer believes that the insects

discussed are the ones most commonly troublesome to the shade trees of this State ; and, with their treatment well understood, it will be easy to apply similar methods in the cases of allied pests.

It will be noticed that, of the insects in the previous list, all but one are amenable to treatment by spraying, although in the case of the brown-tail moth by far the cheapest method is to destroy the winter webs by hand. This leads us to consider the best insecticides for spraying, and the means of applying them. There are certain simple tests by which the merits of an insecticide for use against leaf-eating insects may be determined : it must kill the insects ; it must not injure the foliage ; it must adhere to the leaves for a reasonable length of time : and its price must not be prohibitive.

Three compounds of arsenic fall within these specifications, viz., London purple, Paris green and arsenate of lead. Of these, London purple, while effective and cheap, is open to the objection of being a by-product, and therefore of irregular chemical composition. Some samples contain a large percentage of soluble arsenic, and therefore cause serious injury to the leaves. It settles rapidly in the spraying tank, and requires considerable stirring. It does not adhere well to the foliage, and where its application is followed by repeated rains, a notable burning of the leaves usually occurs. In the market the price of London purple ranges from 15 to 20 cents per pound ; and, as but 1 or 1½ pounds are used to 100 gallons of water, it is by far the cheapest arsenical insecticide. While its use is not advised, should it be adopted, it is well to add 2 or 3 pounds of fresh-slaked lime for every pound of the insecticide. This will convert the soluble arsenic into arsenite of lime, and thereby lessen the burning effect.

Paris green for years has been the mainstay in work against leaf-eating insects. It is probably the quickest in its action of the three insecticides mentioned. Where all the insects it is desired to destroy have hatched and are feeding, and good weather prevails, there is no better insecticide for use than Paris green. But these conditions are almost impossible of attainment in the damp, changeable climate

of New England. Again, Paris green has a high specific gravity, and requires constant stirring. An overdose will clear the foliage from trees even quicker than the insects it may be desired to destroy.

At present prices for copper, Paris green retails at from 18 to 30 cents per pound, and a good article can hardly be bought for less than 25 cents per pound. Paris green is applied at the rate of 1 pound to 100 or 150 gallons of water, and should be used with double the amount of lime, to insure a better distribution and to neutralize any uncombined arsenic. With a strictly pure Paris green the addition of lime is not necessary.

Since the discovery of the value of arsenate of lead as an insecticide by the chemist to the gypsy moth committee, it has come into increasing use as a remedy for shade-tree insects. Arsenate of lead is a white, flocculent poison, of light, specific gravity, remains suspended in water, hence it requires but little stirring, and adheres tenaciously to the foliage for an entire season. While not as quick in its effect on the insects as the two insecticides previously mentioned, this difficulty may be eliminated by increasing the quantity used. Arsenate of lead also will not injure the most delicate foliage, hence the extreme care and accuracy necessary where London purple or Paris green is used are not needed. Because of the general demand for this material, several manufacturers are putting it on the market in paste form, at a price ranging from 15 to 25 cents per pound, according to the size of the package. These pastes carry from 50 to 68 per cent actual dry arsenate of lead, and are very convenient for general use. In large spraying operations, however, it is sometimes desired to make the arsenate of lead from the ingredients, and where skilled labor is available this can be done with little difficulty. The materials necessary are nitrate of lead and arsenate of soda of 96 per cent purity. It is important to get a high-grade arsenate of soda, as the low grades contain a considerable amount of common salt, which will form chloride of lead,—a substance of no value as an insecticide, but which consumes the lead salt. The formulæ to be followed are given below : —

| | lbs. | lbs. | lbs. |
|--------------------------------------|------|------|------|
| Arsenate of lead desired, | 1 | 2½ | 5 |
| Nitrate of lead required, | 1.2 | 3 | 6 |
| Arsenate of soda required, | .5 | 1.25 | 2.5 |
| Total weight of ingredients, | 1.7 | 4.25 | 8.5 |

These ingredients should be carefully weighed, placed in separate packages, and, when wanted for use, dissolved in separate wooden or fibre pails. When the solutions are completely formed, pour the contents of each pail into a spraying tank partly filled with water. Arsenate of lead will then appear as a fine white precipitate.

The above formula are based on nitrate of lead containing 66.5 lead oxide, arsenate of soda of 96 per cent purity (containing 59.8 per cent arsenic oxide), the arsenate of lead required being the actual dry product. It will be noted that the ingredients give a little more than one-half their weight in actual arsenate of lead. The same holds true with the arsenate of lead pastes previously mentioned. The cost of ingredients is a variable quantity. Arsenate of soda 96 per cent pure retails at about 15 cents per pound, and nitrate of lead at about 10 cents per pound; therefore the cost of one pound actual arsenate of lead would be about as follows: —

| | |
|---|---------|
| Nitrate of lead, 1.2 pounds, at 10 cents, | \$0 12 |
| Arsenate of soda, .5 pound, at 15 cents, | 07½ |
| Bags, twine, etc., | 01 |
| | <hr/> |
| | \$0 205 |

To these figures should be added the cost of the labor of weighing and packing the ingredients, and that consumed in dissolving and mixing them. Even with these factors included, the cost of one pound of arsenate of lead is somewhat less than that purchased in paste form. The manufacturers of the pastes, on the other hand, urge the superior merit of uniform composition and availability for immediate use, and the saving of time and skilled labor.

In small spraying operations, where only a few hundred pounds of the insecticide are needed, probably it would be more advantageous to purchase the prepared paste. In larger operations, where a ton or more of the insecticide is

to be used, the parties in charge of the work, knowing their own resources in the matter of skilled labor, and having obtained quotations from reliable manufacturers, should be able to decide readily which form of insecticide is cheapest for their purpose.

For the elm-leaf beetle and the gypsy moth it is desirable to use the insecticide at the rate of 5 or 6 pounds actual arsenate of lead to 100 gallons of water. For the brown-tail moth, tussock moth and fall web worm, 4 pounds actual arsenate of lead to 100 gallons of water are sufficient.

Several park superintendents and city foresters have found advantage in adding glucose when using arsenical insecticides, the theory being that this material causes the poison to adhere in a superior manner to the foliage; and this at one time was our practice in the work against the gypsy moth. Careful experiments, however, involving chemical analyses of foliage sprayed with the same quantities of arsenate of lead but with and without glucose, showed no increase where the latter was used. This result was confirmed by picking foliage from the sprayed trees several weeks after the spraying, and feeding it to caterpillars. The death rate in the two cases was practically the same. There can be no harm, however, in using the glucose, and it is possible that its addition results in a better suspension and distribution of the poison.

Not less important than the subject of insecticides is that of spraying outfits. Of these it may be truly said that their name is legion, and a glance through the catalogues of pump manufacturers will show an assortment of outfits suitable for spraying almost any kind of crop or tree. While there are doubtless hundreds of outfits suitable for use on shade trees, it will be my purpose to mention only a few standard forms, which experience has shown to be of high value for this specific purpose.

First let us consider the needs of the owner of a few shade trees. In many cases he cannot afford, and does not require, the high-priced outfits suitable for park work on a large scale. He can get satisfactory results from an outfit suited for ordinary orchard work, with a slight additional expense

for hose. The bill for such apparatus would be about as follows : —

| | |
|---|---------|
| 1 hand-lever pump with air chamber, mounted in a 50-gallon cask, | \$15 00 |
| 100 feet half-inch white cotton hose, at 10 cents. | 10 00 |
| 1 8-foot $\frac{1}{4}$ -inch gas pipe pole extension, | 1 00 |
| 1 Vermorel nozzle, | 60 |
| | <hr/> |
| | \$26 60 |

Concerning the pump, it may be said that any of the standard makes, operated by a lever and having an air cylinder of one and a half inches or more in diameter, a stroke of five inches or more and a suitable air chamber, will give sufficient force for the spraying of even tall elms; and, as already indicated, the outfit, if properly cared for, would be suitable for orchard and garden work for a term of years.

On large estates or in the case of parks or street trees a more powerful outfit will be required. For economy of labor, the pump should be capable of supplying at least four lines of hose. It should have a large air chamber to regulate the pressure, and its construction should be so simple yet rigid that it can be operated by one able-bodied man. Such a pump has been recently offered in the market and tested in park work at Ipswich, Mass., with most satisfactory results. The bill for this outfit would stand about as follows : —

| | |
|---|---------|
| 1 pump, | \$25 00 |
| Suction hose and fittings, | 5 00 |
| 200 feet half-inch cotton hose, | 20 00 |
| 2 spray poles, at \$1, | 2 00 |
| 2 nozzles, at 60 cents, | 1 20 |
| 1 150-gallon hogshead, | 1 50 |
| | <hr/> |
| | \$54 70 |

Where four lines of hose are to be used, the items for spray poles, hose and nozzles should be doubled. This outfit will effectively spray the tallest trees, and will readily operate four lines of hose where it is desirable.

One of the best outfits ever devised for park or street work is the one formerly in use by the gypsy moth com-

mittee, and which is now being manufactured in a limited way. This apparatus consists of a 100-gallon tank, mounted on a suitable truck for transportation by hand, a powerful double-acting brass pump with agitators, 200 feet of hose, spray poles and nozzles complete, and can be purchased for the lump sum of \$125. The advantages of this outfit over the one previously described are that it requires no team for transportation, the pump is submerged and therefore there is no leakage, while powerful agitators keep the mixture thoroughly stirred. These outfits have been used in the parks of Worcester and Springfield and elsewhere with complete success. There is a question whether more and better work cannot be done with two outfits of the kind previously described, as used at Ipswich; but this is a point which park authorities must settle after examining the respective outfits.

It may seem somewhat strange to pass the subject of spraying outfits without extensive consideration of those operated by power. The writer has carefully examined a large number of these power outfits, secured figures of their cost, etc., and has come to the conclusion that, at least for our New England cities and towns, better and more satisfactory work can be done with the same amount of money invested in hand outfits. A suitable gasoline or steam spraying outfit cannot be purchased for less than \$225, the price ranging upward to \$500. A fair estimate of the cost of the power apparatus would be \$400, and for this sum there could be obtained three outfits such as used in the gypsy moth work, or seven like those used at Ipswich.

The great desideratum in spraying operations is to thoroughly cover the infested territory in the shortest possible time. This can be done by a battery of small outfits much more satisfactorily than with power apparatus. These light outfits permit simultaneous attack over the greater part of an entire city, and with a suitable corps of men the spraying can be done at just the right entomological moment; whereas the same amount of capital invested in one or two power outfits would not permit timely work on a large scale. In addition, where such an outfit breaks down, everything

comes to a standstill until repairs, often expensive, can be made. With the small outfits the temporary loss of even two or three will not prevent the continuance of effective work by the remainder, and, as the parts are interchangeable, frequently two broken pumps can be combined to put one of them into working condition.

Another objection to the use of power outfits is the increased temptation to throw the solution onto the foliage in a stream, instead of in a spray. The pump is backed by adequate power, and nothing is easier for a lazy workman than to open the nozzle and drench the tree, instead of spraying it. Sprinkling is not spraying; drenching is not spraying. The only effective way to spray a tree and have the poison remain on it is to apply the solution as a fine mist. Take a lesson from nature; the dew or fog coats the foliage with minute isolated particles of water, which adhere; the drops of rain roll off. So it is with spraying. The poison in the form of a mist-spray can be drifted into the tree, commencing at the top, and the whole tree can be treated without the loss of a single gallon of the solution. This is the only right way to spray. The poison dries on the leaves, and is in the right place when the insects arrive. I venture to say that at least one-half of the poor results from spraying are due to a lack of knowledge of how to apply the materials to the foliage.

The cost of spraying operations on the scale necessary in park or town work is difficult to compute, yet on no other point is information so much needed by those in charge of trees. The experience of others is the best guide, but even this is difficult to obtain, as most workers very properly devote their energies to spraying the trees, and consequently ignore the details of daily or weekly records of work performed. The writer, by dint of correspondence and personal solicitation, has obtained the statements given below from reliable sources, and would at this time make thankful acknowledgment for the same.

Mr. J. A. Pettigrew, superintendent of parks at Boston, Mass., while holding a similar position at Brooklyn, N. Y., sprayed 8,712 elms with London purple, at a total cost of

\$1,370. This operation included salaries of engineer, foreman, one double team, one single team and six laborers. The trees were from 15 to 40 feet in height, and approximately one-third of them were sprayed twice; thus the cost of once spraying the 8,712 trees was less than 12 cents per tree.

Mr. Wm. F. Gale, at Springfield, Mass., has had long experience in the work of spraying, and, although he has many very large elms with which to deal, he has reduced the operations to almost an exact science. The figures he kindly gave me are as follows:—

| | |
|--|------------|
| Labor, | \$4,069 00 |
| Insecticides, | 357 00 |
| Repairs, | 111 00 |
| Interest on investment in outfits, | 106 44 |
| | <hr/> |
| | \$4,643 44 |
| Number of trees sprayed, | 16,000 |
| Net cost per tree, | \$0 29 |

Certain large elms at Court Square cost between \$10 and \$11 per spraying; but as these trees are of exceptional size, and stand in a busy public square, their treatment was surrounded with more than ordinary difficulties.

While connected with the work against the gypsy moth the writer made a compilation from the daily reports of employees of the cost of spraying 212 large oaks and other open land, first-growth trees, at Brookline, Mass. In this case the laborers were paid a minimum of \$2 per day, and the item for supervision was larger than would be necessary in town or park work. The total expense was about 49 cents per tree. The cost of spraying 1,500 sprout-growth oaks, ranging from 15 to 40 feet high, at Medford, Mass., was similarly compiled, and found to be 15 cents per tree.

At Worcester, Mass., the park commission, through its energetic secretary, Mr. James Draper, has waged a thoroughgoing warfare against the elm-leaf beetle for three years past. The city forester, Mr. Chas. Greenwood, writes me that he never has kept an accurate account of the exact cost of spraying, but estimates it as follows:—

| | |
|--|------------------|
| Trees 8 to 10 inches in diameter, . . . | \$0 50 to \$1 00 |
| Trees 12 to 20 inches in diameter, . . . | 1 00 to 2 00 |
| Trees 24 to 30 inches in diameter, . . . | 3 00 to 4 00 |
| Trees extra large, | 6 00 to 10 00 |

Dr. E. P. Felt, State entomologist to New York, has given this subject much attention, and kindly sends me the data of some large spraying operations.

At Lansingburg, N. Y., a large number of street trees (exact number not given) were sprayed by Mr. H. W. Gordinier of Troy, N. Y., at a net cost of 23 cents per tree. Mr. Gordinier is personally known to the writer, and, as he carries on contract spraying as a side line, his estimates of cost are entirely worthy of credence. He figures that the actual cost of spraying elms as they run, large, medium and small, is from 50 to 60 cents each.

Dr. Felt also writes that in 1900 Mr. F. W. Wells, superintendent of streets at Saratoga Springs, sprayed 5,667 trees at a net cost of $17\frac{1}{4}$ cents per tree. The trees were between 20 and 80 feet in height. The outfit used was a power sprayer with elevated tower.

These varied estimates will give a general idea of the cost of spraying operations as carried on both with hand and power apparatus. It should be borne in mind that in some cases cheap spraying is not always the most effective. The figures given by Mr. Gale are to my mind highly suggestive when applied to Massachusetts conditions, although they are lower than would be the case in the average town or city, because of the large number of small elms which were sprayed from the ground.

The writer's estimate of spraying trees once with arsenate of lead, using a suitable hand outfit, and with labor at \$2 per day, is as follows:—

| | |
|-----------------------------------|-----------------|
| Trees 10 feet tall, | \$0 10 |
| Trees 15 feet tall, | 15 |
| Trees 20 feet tall, | 25 |
| Trees 30 feet tall, | 40 |
| Trees 40 feet tall, | 50 |
| Trees 50 feet tall, | 1 00 |
| Trees 60 feet tall, | 2 00 |
| Trees 70 feet tall, | 4 00 |
| Trees 80 feet and over, | \$5 00 to 10 00 |

These figures will vary with the efficiency of the men, the distance water must be carried, and other considerations that may come in to help or hinder the work.

The question of who shall bear the cost of suppressing noxious shade-tree insects is being settled rapidly by public-spirited citizens, so far as street and park trees are concerned. Such trees being public property, their protection is a public duty, and there is no better index to the character of a community than the care given its shade trees. While municipalities afflicted by outbreaks of shade-tree pests are dealing with them energetically as a rule, there is one factor that often hinders the success of municipal work. I refer to the unrestricted occurrence of these insects on private estates. It profits little to spray street trees for the tussock moth, for example, if on adjoining estates the insects are allowed to run riot and reinfest the treated trees. Such negligence is clearly of the nature of a public nuisance, and should be dealt with accordingly.

If the municipal machinery is organized to care for shade trees in public places, it may well be used to prevent the injury coming from unsprayed private estates, the expense being levied upon the owner, or met from the municipal treasury, as the community may elect. The essential thing is to keep these pests in subjection, but the question of who shall bear the expense has often prevented thorough remedial treatment. A view which commends itself to the writer is that by the suppression of these pests, wherever they occur, property owners in the entire municipality are protected, and hence can well afford to bear their part of the cost in taxes, as a premium paid for immunity from direct loss. It may be that before such operations can be carried on additional municipal or State legislation will be necessary. If the plan appeals to the judgment of tree lovers, let them give it their serious consideration, for the need certainly is a pressing one.

In the matter of tree protection all citizens should take a lively interest. See to it that the care of your trees is placed under proper supervision and in the hands of a competent man. The growing tendency of making all munic-

ipal offices the spoils of political victory has as bad an effect on shade trees as it has upon schools, fire departments or police forces. Illustrations of this point can be found in cities which shall be nameless, where the hand of politics has dropped incompetent men into offices nominally in charge of miles of shade trees, — cities where the elm-leaf beetle and tussock moth have actually killed valuable elms, while those in charge failed to lift a finger until irretrievable damage had occurred, and then contented themselves with sweeping the insects into the gutters, to be farther distributed by showers.

All this is not in keeping with the spirit of the times, and it is the citizens' duty to ask and obtain a change. Springfield, Worcester, Northampton, Plymouth and scores of other municipalities have shown what can be done by intelligent, well-directed effort. The successful prosecution of this work is creditable alike to those in charge and to the enlightened sentiment of a public that has made it possible.

We said at the outset that perhaps it was well that audible speech had been denied our grand old shade trees. Yet, lacking voices, they have spoken to men like Gilbert White, Thoreau, Whittier, Holmes and Bryant, — men in broad and complete sympathy with nature in all her forms. And sympathy was the key which unlocked the portals and let them into closest association with the whole living world. We need more of this feeling for all manifestations of life. And when we obtain it, we too may hold converse with the tree guardians of our dwellings and streets. Let us so act that the messages they may bring us shall not be the sad notes of neglect or reproach, but rather the sweet harmony of a beautiful, peaceful existence.

EX-GOVERNOR HOARD. The lecturer spoke very slightly of the English sparrow, and I do not owe him very much good-will, but I do know a few things about him, and I am impressed with the thought of where the English sparrow gets its food for its young; for every single bird on earth, except the pigeon, feeds its young on animal food, and

may it not be possible that the English sparrow helps a little while he is rearing his young?

MR. KIRKLAND. I think a paper has just been published by Mr. S. D. Judd, on the "Food of nestling sparrows," that covers that point very well. The sparrow feeds its young in part on spiders and soft-bodied insects, but changes the diet to grain as soon as the young can stand it.

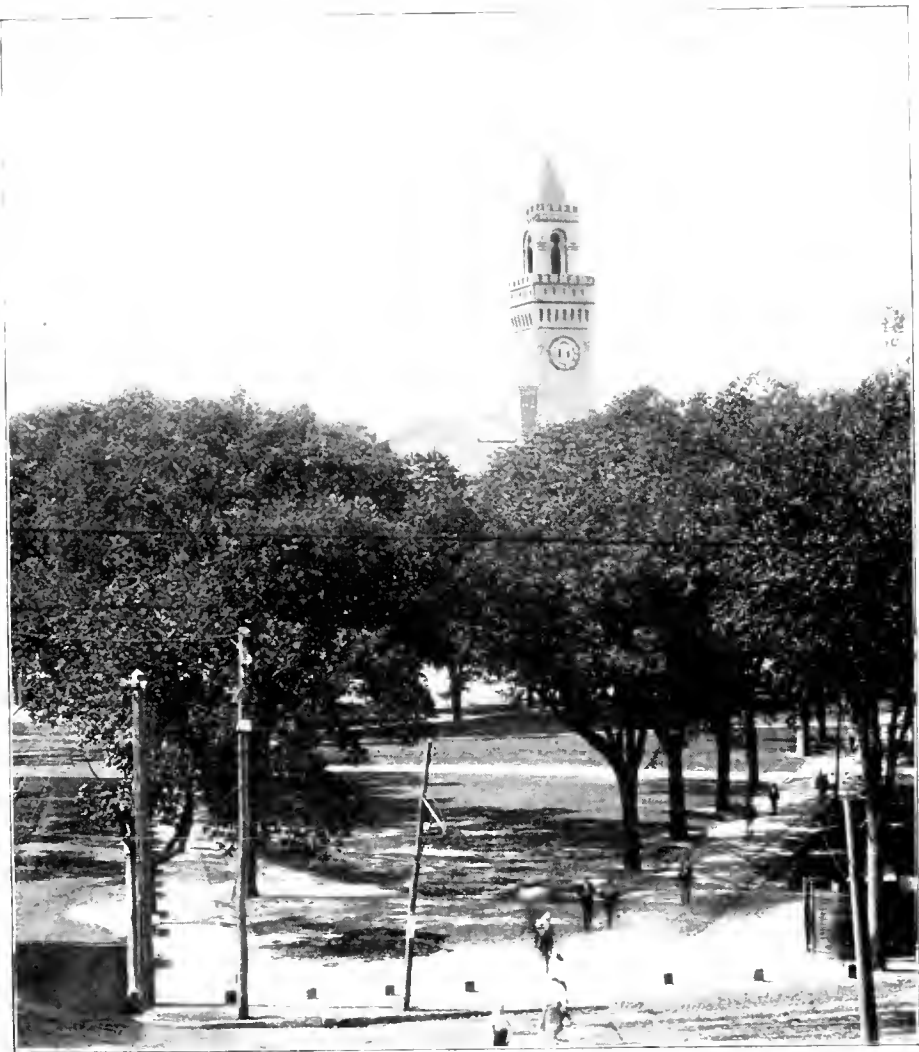
EX-GOVERNOR HOARD. I have seen them feed them on cabbage moths when nearly full grown.

MR. KIRKLAND. There is no question but they eat more or less insects, but of course they are grain-eating birds, and should not be classed as insectivorous birds.

MR. JAMES DRAPER (of Worcester). I should like to say a word or two to supplement one or two points not brought out by the lecturer. In addition to the treatment he suggested, we commenced the scraping of the bark of the elm trees, going up fifteen to twenty feet from the ground, getting off all the bark we possibly could and gathering it and burning it, and in that way we destroyed millions and millions of the pupæ. Then, in addition to that, at the first treatment, several years ago, we sprayed the trees with kerosene emulsion, but we gave up the spraying process later, and took a stiff fibre brush which we could rub up and down quicker than we could spray the trunk.

MR. KIRKLAND. The spray used was for the trunks of the trees?

MR. DRAPER. Yes. Then we followed up the spraying process as suggested by friend Kirkland very effectively, and wherever the work was thoroughly done the trees were preserved. But we ran across this trouble: parties owning trees on private estates did not care to have them sprayed, and those trees would be the nesting place for a large quantity of beetles, and those trees have been injured very seriously. There is the great difficulty that we labor under. We take care of our shade trees and park trees and perfectly protect them, and yet the owners of private trees do nothing, and their trees are injured. You say, "Why don't you go in and take care of them?" We have no right to enter upon private estates for that purpose, nor have we



Elms of Worcester Common protected by spraying
from injury by elm leaf beetle.

any right to take public funds to apply on private estates. We got a ruling from the city solicitor, to see if we had the right to do it. He said, "If you have a right to do it for the elm-tree beetle, you have a right for any other pests." I think it is the particular province of a meeting of this kind to discuss and see if there cannot be some measure provided to get help in this direction.

One word more in regard to this equipment. Instead of having one or two large outfits, we had ten constructed, and had them made to order after the pattern used by the gypsy moth committee. Instead of iron fittings inside, we had them made of brass and composition, so there was no rusting. Instead of two wheels, we have them on low, four-wheeled trucks, which are easier to handle than these tall, ungainly wheels. We have ten of the pumps, and they are doing very decent work.

CITY FORESTER GALE (of Springfield). The essayist has covered the elm-tree beetle question so thoroughly, I do not think I can say anything more in its favor. But our experience has been that spraying thoroughly protected the trees. If the trees are thoroughly sprayed in the early part of the year, as soon as the foliage is established enough to bear the treatment, fully developed, the trees will go through the season without any damage from any leaf-eating insect. As far as the trouble from private estates is concerned, that is the great problem. We have in our city a good many public-spirited people, who are willing to pay their share of the cost and glad to have their shade trees sprayed. We treat all those at the expense of the owners. Our earnings this year have been, perhaps, a thousand dollars from that source. But there are a great many whom we cannot reach, from the fact that, as has been stated, we have no authority for going in there, and of course have no right to expend public money for that purpose. But there should be something done. The law of France that the speaker has referred to is just what we want. We want to have something to compel the property owners who are indifferent and care nothing for the general appearance to allow us to spray their trees and rid their premises of injurious insects. I hope

the time will come when we can do that. There is but one sure protection against the elm-tree beetle, and that is by thoroughly spraying the foliage, and that applies also to other beetles and insects, as the speaker has said, and he has covered the ground very thoroughly. The apparatus we use with the best success is the one used by the gypsy moth people. I have fourteen small fifty-gallon cask pumps and two of the larger ones, and I shall use two more this season. The importance is in doing the work promptly. The entire city or town wants to be covered within a given time. When one section of the town is ready, it is all ready, and it is important to have sufficient apparatus to cover the whole territory at once as nearly as may be. If it can be done within ten days, all the better. I mean to cover our entire section within three weeks, unless weather prevents.

QUESTION. What insecticide do you use?

MR. GALE. Arsenate of lead.

THE CHAIRMAN. Isn't there considerable that can be done by the individual with the beetle?

MR. DRAPER. In the larval state, of course, individuals can destroy thousands by simply brushing them down every morning. We have one lady in our city who is very much interested in the matter, and I cannot say now how many thousands she has gathered, but a great many of them. She has a little cotton band covered by newspaper, where the larvæ gather during the night, and every morning she takes them out by the quart, or in great quantities, and destroys them. A great many of the larvæ come down trees that are not sprayed. It is not always that they come from the tree they are on. Sometimes they come from other places, where no insecticide is used. We have had experience this season with trees that had been thoroughly sprayed where larvæ came down, and it was reported by some of the newspaper people that they were thoroughly eaten up from the larvæ of the beetle. Within fifty feet of these trees were two trees on private grounds that had not been treated. Before the larvæ had finished feeding, those trees were stripped, while the trees that were sprayed were perfectly green.

MR. PRATT. I would like to ask, have you any evidence

of trees that have been stripped for several years being entirely destroyed or killed?

Mr. DRAPER. We have had only a few. We have had the beetle now six years. There are two trees which have been stripped three years repeatedly, which are not entirely dead, but the greater part of them is dead.

Mr. PRATT. In case of the gypsy moth, two or three strippings were death to the tree; but I think the elm-tree beetle does not work as severely on the tree as the gypsy moth.

Mr. DRAPER. I would like to say that I had a correspondent in Paris who told me that three or four hundred trees had died from repeated strippings, and that three or four defoliations would kill them out entirely. But I think the American elm would stand more. The English elm might give it up after three or four years.

Mr. BABB. One thing that remained with me from the morning, brought out by Mr. Clark, was in regard to the use of glucose with the arsenate of lead. The question was not answered exactly this morning. I should like to ask Mr. Kirkland about the use of glucose, — whether it is necessary.

Mr. KIRKLAND. In the early days of the gypsy moth we used glucose as a matter of course, and had faith in it; but there were some things that led us to doubt the advisability of using it, and we made a series of experiments. We sprayed some oak bushes with glucose and arsenate of lead, and other bushes with the arsenate of lead in the same proportion and no glucose. Professor Fernald with Mr. Forbush saw those bushes a few weeks after. They could see no evidence of difference in the two lots. We took the foliage at the end of about six weeks, counted a number of leaves from each bush, and fed them to caterpillars. The killing of the caterpillars was practically the same in each case. In September, some months after the spraying, we cut whole bushes and picked off the leaves from each lot, and had an equal weight of those leaves examined by a chemist, and he found practically no difference in the amount of arsenic present. The next year we dropped the use of

glucose and sprayed with arsenate of lead with no glucose, and it was the most successful year we had ever sprayed. Perhaps the greater success was due to the improvement in the outfit. I do not think the glucose helps the poison to adhere. It may, by making a more dense solution, insure a better distribution of the poison. The chemist told me that after the first rain you could find no glucose on the leaves.

Mr. BABB. I asked the question because it seemed to me Mr. Clark was a strong advocate of glucose, and my opinion was it was not necessary, an unnecessary expense, so might as well be saved.

Mr. CLARK. I would answer that question in regard to glucose that the expense of it is almost nothing, and it does make the arsenate of lead adhere most thoroughly. I began the campaign against the elm-beetle the earliest of anybody in this valley, probably. I commenced with one three-horse steam-power boiler, and I think for all large towns and cities it is well to have one steam sprayer for the work, because it is very difficult to put ladders up 70 and 80 feet, and we have trees here nearly 90 feet high. With a steam sprayer we can spray these high trees very fast, and by an attachment we have on the engine we can spray two small trees at the same time with the steam sprayer, — trees 30 or 40 feet high, if it is required. Of course for the smaller trees of the town, I think it certainly is well to have the Ware pump that has been spoken of here. I believe that is the one used in Worcester.

Mr. DRAPER. Yes.

Mr. CLARK. In buying that pump I wish to say this, you want to buy it entirely with brass connections, because those fitted with steel or iron will corrode. With brass fittings it can be used for years. I have prepared a little paper for superintendents of parks, part of which I would like to read to you, because it gives a hint of how to commence the work : —

First, examine carefully, in the month of July, all the elm trees under your care, and see if any of the leaves are skeletonized, — that is, if the green portion of the leaves is eaten out and the skeleton left.

Second, nail a galvanized-iron tag about one inch square on all trees found infected in the slightest degree, making an accurate list of all such trees and the exact location, taking in also all trees on private ground adjoining, so as to know just where to begin the work.

Third, get your apparatus purchased before the month of May, or this coming winter, if possible, so as to be ready for your work next spring.

The apparatus should comprise, for ladders, one three-section extension ladder, 60 feet; one two-section extension ladder, 45 feet; one single ladder, 35 feet; one single ladder, 20 feet; one single ladder, 12 feet, for each gang of five men where both large and small trees are to be sprayed.

The best sprayer that has come to my knowledge is the Ware hand pump, made for and used by the gypsy moth committee. It is fitted with hardened brass fittings, is worked by one man, and will spray two trees at once, but not quite so rapidly as a steam pump sprayer.

When there are a large number of large trees, 50 to 80 feet high, I recommend a two to three horse-power boiler and a duplex steam pump. The one I use is manufactured in Springfield, Mass., and will rapidly spray trees 80 feet high by using a little larger nozzle for the top branches. Be especially careful to spray both sides of the leaves, as the beetle attaches its eggs on the under side of the leaf, and the worms begin to feed there as soon as they are hatched out. The early spraying is then far the most effective, as it kills both beetles and worms. Always commence spraying at top of the tree.

Spraying poles 10 feet in length with attachment for nozzles can be had for \$3, and are very valuable for high spraying.

Although you want for most of the spraying work a nozzle that will spray, I find it better to use a little larger straight-tip nozzle, so as to be sure to thoroughly wet the top branches of high trees, — the most difficult work to be done, as the beetles resort there when driven from the lower part of the trees.

A low one-horse truck for transporting the hand-pump,

100-gallon truck and other apparatus, can be bought for \$35, and is just what is needed for use in the field or street.

In regard to scraping the bark off, since we have the arsenate of lead spray I don't think there is need of it. Taking all the bark off the tree certainly has a tendency to make its bark too thin for winter protection, and is liable to injure the tree. I have had pretty good success. In Florence I commenced spraying about five years ago, and we have practically exterminated the beetle.

The question has been asked about the killing of the trees. You can go through Longmeadow, a town that has been neglected, they haven't sprayed at all, and see the ends of the trees dying. If you neglect the tree, it is certain to die. If the trees are not sprayed, they will commence to die down.

Dr. H. T. FERNALD (of Amherst). It seems to me there are some items that should be spoken of with reference to how far our authorities permit us to enter upon private property for the control of noxious pests. That question, I think, is one of the most important we shall have to deal with in the next fifty years, because the number of insect pests is spreading rapidly all over the country, and they are not paying any attention to property lines or fences. The park or the city authorities may clear all the public ground of those noxious pests, but if they are unable to control those pests on private grounds, and the owners of those grounds do not co-operate with the public authorities in the matter, any attempts come to no result. The question has recently been discussed as to the power of public authorities to enter private grounds for those purposes, in a meeting of official horticultural inspectors of the United States, held at Washington some two weeks ago. At that time it was decided that the present laws in most of our States are very defective, in that they do not make clear that the authorities have a right to enter upon private property, or in some States they said that they have no such right, and that a person so entering upon private property is liable to a suit for damages. It was the sentiment of that convention, at which I was present, that this was a very unfortunate condition of affairs, but never-

theless it was the present state of the case, and the only way of controlling insects and other pests distributed impartially on public and private grounds was by co-operation of the public authorities and private owners. Unfortunate as this conclusion may be, it is at all events the condition which confronts us at the present time; and we must work either on that basis or work for a change of our laws that will recognize, perhaps, what we consider the law of "public nuisances," and obtain an application of that law to public pests. Perhaps in that line we may look towards relief in the future, if we do not have it at the present time.

Mr. Kirkland has said, if I understood him correctly, that one-half of the failures of spraying were due to not knowing how to apply the spray. I entirely agree with Mr. Kirkland in that, and I would like to add that in my opinion the other half of the failures in spraying are due to not knowing how to make the material to put on. Anybody who has tried to make up arsenate of lead from the chemicals, and who has gone to a drug store and bought those chemicals and run his risk of the adulteration, and has tried to get arsenate of soda 96 or 98 per cent pure, and then gone to work and tried to get it into a gallon of water in the proper proportion, — by the time he has done that he is generally a pretty thoroughly mixed up man the first time, and sometimes a good many times thereafter. That is one reason why Paris green remains in favor. Most men I find start out with Paris green, and they say it is because they have only to dump it into the water. They get mixed when they try to prepare insecticides. The trouble is, we need more or less of chemical training to keep us from dropping into pitfalls. They are all about. I have never seen a man that succeeded in making a kerosene emulsion, that was an emulsion, the first time. For that reason I think we must look for a fixed supply of definite insecticide materials; and I do not know but that it is the natural modesty of the speaker who has just concluded, but it seems to me he has left something unsaid. Mr. Kirkland could not speak from his position as I am able to. I acknowledge the feeling that we must have an insecticide which demands only the addi-

tion of water or only simple treatment to prepare. I do not believe in advertising in a general way, but where I can honestly recommend a thing I feel it is as much my business as to put down a moth catcher such as they got out in Missouri last year. I consider that the Bowker insecticides, among others, are excellent and reliable; and one of the best points about them is, there is no weighing out so many ounces of this and that and heating it in a steam boiler, and stirring it so long, and perhaps muttering a charm as you do it, but you have it right in hand, and that is where it should be every time except for those of us who have opportunity to experiment and practise until we get the results well under our control. These gentlemen have a great advantage over the average man who has his spraying to do in a hurry, right then, with other work pressing in every moment. If I had acquaintance with other firms, I might be able to say the same thing. I have not that fortune. I speak of what I know.

The brown-tail moth has been spoken of. Let me say that one of my duties as one of the nursery inspectors of the State has taken me into nurseries in several parts of the State, and in several of these nurseries the brown-tail moth is abundant. That means if men buy nursery stock they are liable to bring the brown-tail moth here, or to Pittsfield, or anywhere in this State or other States; and the only protection you have against the brown-tail moth or the San José scale is such protection as is given by requiring the nurseryman to give a certificate that his nursery has been examined and none found. The failure to do that has cost the loss of thousands and thousands of dollars to this State, and is going to cost the loss of many thousands of dollars more in the same line. It behooves every man who intends to be careful about the stock he buys to see that it is covered by a certificate that declares protection to that stock.

MR. DRAPER. In the line of what Dr. Fernald has said, I wish to emphasize the same point brought out by what he said. I am a student under our friend Kirkland in this matter of insecticides, and while he was with the gypsy moth committee, he came and gave us instructions in the preparation of kerosene emulsion and its application, and

we followed his directions and the result was satisfactory. I omitted one part of my little talk about the use of kerosene emulsion. I spoke of simply using it on the trees. Instead of resorting to hot water, as suggested by my friend from Northampton, we sprinkled the trunks and around the roots of the trees with kerosene emulsion. I think that is easier than to try to keep water hot.

MR. CLARK. I would answer that by saying I have experimented upon the larvæ and pupæ with both, and it was found the hot water was more effective. The other is good, there is no question about its being very good indeed, but when you put on the hot water there is no possible escape. When you put on the boiling hot water, everything is gone as far as life is concerned. The hot water costs nothing, and the kerosene emulsion costs considerable.

MR. DRAPER. It is not the purpose of the speaker to advertise anybody's goods or to advertise Mr. Ware's pump, but that is, in my judgment, the best equipment for our park and street work. You are obliged to have your ladder men as well as the tree men, that we call "squirrels." You have to have the ladder men, and they can just as well work the pump, and one of these pumps will run four lines of hose on most of your trees, and that is about as fast as you can do it. I don't believe it is policy to go into the steam pumps.

One word more. Our experience in making arsenate of lead was fairly satisfactory. We took the formula from Mr. F. J. Smith of the gypsy moth committee and tried to make it ourselves, and it was fairly satisfactory. But when Mr. Kirkland went into this company and they put out a material that all we had to do was to put it into the tank all ready mixed, I thought they were doing a great service to those fighting the insect pests, and I use that chemical as furnished by them, and it has been entirely satisfactory to us the past year.

THE CHAIRMAN. It seems to me it demands a little explanation as to the Ware pump and the arsenate of lead. The committee who had charge of the gypsy moth work felt the necessity of a better insecticide than Paris green, because of the danger of burning the foliage, and the

complaints that were brought in from private individuals that their trees were injured. A chemist was employed and set at work, the committee getting all the hints from other chemists possible for the chemist they employed. Professor Fernald was consulted, Dr. Wellington, Professor Shaler and others, and hints were gotten from all sources possible, and this chemist put them in practice and tried everything, first one thing and then another and another, and the outcome was arsenate of lead. This morning perhaps undue credit was given to the chemist who did the work. He did the work, but he got hints from educated men everywhere. Probably a hundred different compounds were suggested and tried, and none of them excelled Paris green until we struck the arsenate of lead, and that filled the bill.

In regard to the pump, we found in the immense amount of spraying we were obliged to do, on trees one hundred feet high, bushes and all kinds between, over hundreds of acres, we must have better facilities for spraying than we did have. We found a man willing to work under our direction, getting hints wherever he could, from experienced men, scientific men and practical men, and put them together for this spraying machine. That man was Mr. E. C. Ware. Mr. Ware made this machine for the State of Massachusetts, and the State of Massachusetts paid the bill, as it paid all the bills for the discovery of the arsenate of lead; and when the committee made the contract with these men, it was agreed that any discovery they made under the pay of the State of Massachusetts should not be patented, but should be reserved for the use of the people of the country, free, and that is the condition of the arsenate of lead and of the Ware pump. If you can make a Ware pump, you have a right to make it. If you can make arsenate of lead, you have a right to make it.

With reference to Mr. Bowker's arsenate of lead, he did not invent it. He puts together the invention that the State of Massachusetts made, and if he can put it together better than anybody else, he is the man you ought to buy it of. If he is not, then you ought not.

Professor BROOKS. Many of you know that all trees or shrubs which come from Japan are, as a rule, free from the attacks of our insects. The Japanese insects prey upon them to the same extent that ours do. When I came from Japan I brought a few Japanese elms that I found growing wild about the country where I lived. I do not know whether I have the only tree of the kind in the country or not. I think perhaps Professor Sargent has them now, because he has been over the same ground recently. This tree that I speak of was planted where it stands, behind my house, in the spring of 1890. It is now about seven or eight inches through at the butt and about thirty feet high, a very shapely tree. All the elms I saw in Japan were shapely trees, — perhaps not equal to ours, but very shapely. This tree is not attacked by the beetle. It stands in the midst of native elms. This past summer those elms were stripped, while the Japanese elm was not injured appreciably. This is a point some horticulturist or nurseryman may like to know. I hope efforts will be made to introduce the tree here, because it is a means of enlarging our resources. It is a handsome tree, altogether apart from whether it proves permanently to be free from insects.

Prof. C. H. FERNALD. I have a word to say very briefly upon what Professor Brooks has said. A year ago last summer, while in Plymouth, Mass., I went to the famous old graveyard, and there saw the elm trees being defoliated by the elm-beetle, and after they had stripped those they went to the *maple trees* and stripped the maple trees. That is why I asked Mr. Gale the question, to see whether the elm-tree beetle has been found going to other trees. If they would take the American and the English elm trees and strip those, and then go to the American maples — a red maple, I suppose it was — and strip those, I should doubt whether any species which came from any country would be safe. They would naturally have a preference for that food plant, and would take our American elms first; but after they had done with that food I should doubt, from what I saw in Plymouth, whether they would not eat the other trees as well.

The CHAIRMAN. I think canker worms do the same thing.

Professor BROOKS. I do not care to prolong this discussion. I stated simply a fact. Other neighboring trees were depleted, and those Japanese elms were not. As far as the taste of the insect is known, I believe all destroy the leaf, and this elm has a thicker and more hairy leaf. It might be possible the beetles would eat it. I do not pretend to say they would not. I simply state the fact observed this past season.

EVENING SESSION.

The evening session was called to order by Mr. A. M. Lyman of Montague, delegate from the Hampshire Agricultural Society, who introduced as the lecturer of the evening Maj. Henry E. Alvord of the United States Department of Agriculture. The lecture, "Dairying in France," was illustrated by the stereopticon.

DAIRYING IN FRANCE.

BY MAJOR HENRY E. ALVORD, CHIEF OF DAIRY DIVISION, UNITED STATES DEPARTMENT OF AGRICULTURE.

Dairying is a prominent feature of the agriculture of France, and the industry takes very different forms in different parts of the country. It is therefore necessary to travel about, and often in paths not frequented by tourists, in order to find the places of special dairy interest.

After a visit to the islands of the English channel and the homes of Guernsey and Jersey cattle, one may cross the narrow strip of sea, only 15 miles wide, and land upon the west coast of France, in the old province of Normandy. Any one of a number of little towns, all noted as dairy centres, will answer as a stand-point from which to get a view of Normandy, its cattle and its butter making. Carentan is a good location, a place of about 3,000 inhabitants, at the head of an inlet or arm of the sea, which is kept dredged so as to afford navigation for 12 miles down to the English channel at Isigny. The farms in this vicinity are quite large, and mainly in grass. It is a tide-water region, and much of the land is low. The pastures are permanent and the herbage superb.

The very best of the Normandy cattle, of which France is so proud, — the Cotentin strain, — here abound. They are large, coarse, heavy-boned, but sleek and fat. In color they are red, brown and white, spotted and brindled. They have a very wide, heavy, homely face and muzzle, but good full eyes. The udders are often large, but irregular in shape, with very large and puffy teats. Good cows average 8 to 10 quarts a day for 10 months, or 5,000 to 6,000 pounds of milk per year. It requires 12 quarts of milk in the winter and 15 in the summer to make 1 pound of butter. The

butter product of good cows is therefore 200 to 225 pounds per year; ordinarily 100 pounds a week from 20 cows, rising at times to 125 or 130 pounds.

An American dairyman would see little about these cows indicative of economic dairy quality, and would hardly choose them for "dual purpose" animals, yet some cows among them are claimed to be very profitable. The calves are simply marvellous in size, thrift, rapid growth and fatness, making veal of the highest quality, and selling at prices which make one of the most important sources of farm revenue. Good calves, 6 to 8 weeks old, often sell for \$25 to \$30 each. I several times saw carcasses of veal which weighed 250 pounds and over; these calves, when alive, must have weighed over 400 pounds, and they were not 2 months old.

The cattle roam in extensive pastures, often at some distance from the farmstead. During the very long pasture season, including parts of winter, the female members of the farmer's family, or laborers, usually women, may be seen twice a day travelling over the farm lanes and country roads in little donkey carts, or mounted on donkeys, and surrounded by numerous milk pots or cans, closely resembling those used in Jersey, but running in larger sizes. The cows are sought in the fields, and often found much scattered. They are not called, and do not come up to be milked. The milkers pass from cow to cow, and, kneeling on the ground, or in the position known as "sitting on one's heels," milk with both hands, or one, directly into the small mouth of the milk pot, or, in somewhat rare cases, onto a strainer cloth stretched over the opening. The can covers are carried along, and when a can is full the cover is put on, and the can left standing on the ground, perhaps in full sunlight, until the end of the milking. The hours from 5 to 7 form the milking period, at both ends of the day. When completed, the donkey (which has meanwhile been grazing and wandering about, perhaps carrying the cans to the most distant parts of the field) is driven around to pick up the scattered vessels of milk, which are then carried to the farm-house.

This building is almost always of stone, and on a shady side a room has been set apart, with very thick walls, one or two small windows and a stone floor, for keeping the milk. Often it is empty except for the supply of heavy, earthenware jars, which hold from 12 to 20 quarts of milk each. These are called *terrines* (earthen jars) and *chaudières* (warmers). These vessels stand upon the floor or on a permanent bench around two or three sides of the room. Into them the milk is strained on arriving from the field, and atmospheric temperatures alone are depended upon for cooling. Natural ice and cold water are scarce articles hereabouts. These milk rooms are never cold, but, on the other hand, they never get very warm, even in mid-summer. They are kept well whitewashed and scrupulously clean in Normandy; and, considering the large bulk of milk set in one vessel and the want of care prior to straining away, the milk keeps sweet an astonishingly long time. The milkers are by no means as clean as might be, in person or dress; the metallic pots are never steamed and rarely scalded, but are washed clean and aired. The cows are in the best of health, with the purest of food, but they have poor water; their bodies are clean, and they are always milked in the open air with cleanly surroundings.

If the milk sours in less than 24 hours, as it seldom does, it is churned entire; otherwise the milk is skimmed at the end of 24 or 36 hours, and the cream churned the same day, or the next. Those who pride themselves upon making butter of a superior quality skim 12 hours earlier, and not closely, thus getting the very best of the cream; the remainder is considered well used when fed with the skim milk to good calves. Churning ordinarily occurs every morning, and early, while it is cool. The cream when churned has developed but little acidity, and the butter has a mild and rather flat flavor. Pure cultures, ferments and starters are unknown. Dash churns are used, both of vertical and of barrel form. Some horizontal barrel churns are operated by a one-horse sweep-power. The butter is gathered in the churn, in mass, and, after very thorough washing, lifted out and worked in a wooden bowl or long tray with the bare

hands. Salt is never used, — at least not at the farm dairy where churning is done. In cleaning the churn at the final rinsing, a bunch of the common nettle plant (*Urtica urens*), fresh or dried, is shaken about in the churn. No reason is given for this, except that it has always been done : yet some, on being pressed, say they think it helps to cleanse the churn, and others that it “makes the butter come.” The churning seems to be exhaustive and the butter is generally well made, although rather over-worked. No fat testing is known, and no means exist of telling whether fat losses occur in the skim milk and buttermilk. These by-products are, however, always judiciously fed to calves or pigs. The milk room is sometimes large enough to accommodate the churn and churning, but ordinarily this work and the general dairy cleaning is done in an adjoining room, where there are provisions for a fire, and a set kettle. The premises and utensils are usually kept very clean : the work is done by women, and there is no stinting of labor. There is no scientific practice or study of problems involved : all is done according to traditional rules and habit : yet the average butter of Normandy is well made and good of its kind.

Twice a week the farmers' wives or daughters take the butter to market at the neighboring town or village. It is prepared early in the morning, formed into big lumps, wrapped closely in large, coarse linen cloths, and put into wicker baskets of the shape of a flower pot. This form or lump of butter is called a *motte*. If quite warm, the mottes are made smaller than the baskets, and between cloth and basket the space is filled with clean, unbroken wheat straw. Straw is drawn over the top, unless the basket has a good cover. These baskets vary in size, and the mottes of butter weigh (net) from 8 or 10 to 50 or 60 pounds. They are carried to market in the one-horse farm road cart common to all western Europe, or in a smaller donkey cart of similar pattern, or in paniers on a saddle animal. From 10 o'clock until noon on the proper days, the roads leading to the market towns are filled with the neatly and plainly dressed country women of Normandy, carrying their butter to the sale.

About 11 o'clock the buying begins. In the market place, or on the village common, buyers have arranged receiving enclosures or booths, with provisions for weighing and for paying. These buyers represent Parisian or other merchants, or the large factories at which butter is manipulated and further prepared for market. The country women gather around the square with baskets on the ground. As a buyer approaches the package is uncovered, the top of the motte exposed, and the buyer, with a peculiar knife or little tryer, examines the butter and makes an offer for it, at the same time placing marks on the surface of the butter, indicating, in characters secret to his house, the grade of the article and price offered. If the owner rejects the offer, these marks are obliterated, the top of the butter smoothed and another buyer awaited. If accepted, the basket is at once taken to the proper stall, the motte removed, unwrapped, weighed, and reported to the book-keeper and cashier at hand. The butter is weighed on a peculiar platform counter scale or by steel-yards, and unprotected, exposed to sun and storm, dust or rain. The weigher picks up the lump of butter in his hands and sends it sailing through the air to an attendant at a very large, linen-lined basket, ready to receive butter of the special grade to which this is assigned. The owner is paid cash at once, and retires, with empty basket and plethoric purse, to gossip, or "shop," or return to the farm.

This butter buying at local country markets in France is done with remarkable rapidity. Of course the buyers know well the various makers and the usual quality of their butter; but every lot is tested, and a decision as to grade and price must be stated and marked. At a market which I witnessed at Carentan, held on an August day in the shadow of the fine old church of the fourteenth century which this little town possesses, there were 20 buyers, representing 4 purchasing firms or factories. In most cases the butter was examined by only one person, the sale being virtually fixed in advance, but very many mottes were tested three or four times. The number of makers represented and the total number of mottes could not be determined, arriving sellers

so rapidly replaced those retiring; but there were several hundred. The cases were few where one person offered over 50 pounds. The best buyers worked at the rate of 150 lots of butter per hour, and in two hours that day an aggregate of over 100,000 pounds (or 50 tons) of fresh (unsalted) Normandy butter arrived, was tested, graded, sold, delivered and paid for. The sales of this town sometimes exceed 60 tons on Mondays, but are less in quantity on Fridays. The butter purchased was placed by the buyers in 13 different grades with as many different prices, ranging from 15 to 30 cents per pound, and averaging 24 or 25 cents.

Most of the butter bought at these country markets in Normandy is taken for the proprietors of large establishments which are really *blending* factories, — a kind of butter factory hardly known in America. One of the oldest and best known of these is located at Carentan. It is a big concern, employing at least 600 persons altogether, receiving 25 to 40 tons of butter a day in a dozen different grades, which is mechanically blended, repacked and sold in four commercial grades. Sales amount sometimes to 100 tons in one day, although ordinarily only about 30 tons. The business of the year aggregates 9,000 to 10,000 tons of butter, worth from \$4,000,000 to \$5,000,000.

South of Normandy is the old province of Brittany, with its excellent little dairy cows, black and white, and its entertaining and picturesque peasantry. But the dairying of this region does not differ much in character from that of Normandy. It is not as well conducted, and the butter product ranks lower in quality and price. There is an agricultural college with a dairy school annex in Brittany; and away to the west, not far from Brest, an excellent practical school of dairying for the daughters of peasant farmers. It is thoroughly a dairy maids' establishment.

Should one travel still farther south in France, keeping within 50 miles or so of the west coast, the old province of Poitou would be entered, lying between the rivers Loire and Gironde. In this district, and particularly in the departments of Deux-Sevres, Vendee, Charente and Lower

Charente, is to be found the best French development of the co-operative system of butter making. The first factory under this system was organized in 1888, with 88 patrons, and produced that year 65,000 pounds of butter. There are now more than 100 of these co-operative creameries in the region described, with 50,000 patrons, owning 125,000 cows, and producing annually about 17,000,000 pounds of butter. Most of these establishments are less than eight years old; they have organized in a strong association. The industry in this region has been developed in a former wine-making country, where the vines were destroyed, from ten to twenty years ago, by phylloxera. In the rest of France there are another 100 creameries, but most of these are proprietary. Half of them are in western departments, and the rest are scattered through other portions of the country. There is nothing instructive in these French creameries, and they are hardly worth a visit.

Paris and its milk supply, with the producing farms, are the next form of dairy to be considered. The main point of interest is the endeavor to conduct the milk service of this great city almost entirely without provisions for cooling milk, on the farms, during transportation or in the city, either by dealers or consumers. Failure to give satisfaction to anybody is the natural result, and sweet milk is a rare article in Paris during warm weather, excepting two or three hours immediately after the deliveries, which take place twice a day and sometimes thrice. A few of the largest milk supply companies do cool milk at their city depots, when they succeed in bringing it sweet from the farms; and there are a very few milk farms fairly up to date along some lines, within easy access of Paris. Such an one is the celebrated farm of Arcy in Brie, where about 200 cows are kept, and which was the first, so far as known, to regularly deliver milk to city consumers in sealed glass or porcelain vessels of small size. The Arcy sealed jar of white opaque glass, holding one litre (or large quart), first appeared in Paris in the year 1873. This is still in use, notwithstanding its great weight and its clumsy metallic cover. At this farm, and very generally in connection with the city

milk supply of Paris, the chief reliance for preserving milk is pasteurization.

It is well worthy of note that at a special show of perishable dairy products, held as an annex to the Paris Exposition, in July, 1900, just outside the city limits, where French producers had every opportunity of exhibiting their goods in the best possible shape (although under unfavorable local conditions after reaching the exhibit), there was a large collection of natural milk and cream; but the only samples of these products, absolutely free from chemical preservatives, and uncooked, which were sweet and palatable after noon of the exhibition day, were from dairies in New York and New Jersey, then 18 days from the cow! There was also in the United States dairy exhibit natural milk and cream from a farm in central Illinois, in bottles exactly as sent daily to Chicago families, which was only very slightly acid, although 20 days old. It had kept sweet until the day before this show, and even later it was better than the best normal French milk only 12 to 24 hours after milking. The American products had been preserved solely by cleanliness and cold.

In the northern part of France, or the territory lying between Paris and the Belgium border, the dairy industry is not especially developed, and presents little of interest. Large farms abound in that region, with extensive cultivation of wheat, barley, grass, sugar beets and potatoes. Almost every estate has some industry, like the making of sugar or starch or alcohol. There is also an active live-stock interest, but horses, beef cattle and sheep receive most attention. There are mines in this region also, — coal, iron and lime, — and numerous large manufacturing towns, such as Amiens, Arras, Douai, Lille and St. Quentin; so that there are large local markets for hay and all forage, and, so far as there is dairying, it is nearly all for making milk for town supply. Yet this part of France and particularly French Flanders is the home of a race of cattle not widely known, which furnishes by far the best dairy cows in this part of Europe. These are the Flamandes, a large-framed, rangy, dairy type of cattle, uniformly dark-brown or almost black in color, healthy, active and docile, good feeders and pro-

ducers of large quantities of rich milk. These cattle justly won the sweepstakes prize for dairy animals at the Paris Exposition stock show. But it is said they always deteriorate rapidly when moved from the comparatively small district in which they had their origin or development, and this accounts for the breed being so little known elsewhere.

To find other interesting dairy districts in France one must therefore travel again to the south, and fully half way from Paris to the Mediterranean Sea. This brings one into the old province of Auvergne, that very beautiful mountainous district which covers the present departments of Puy-de-Dome and Cantal. It is an elevated territory, near the centre of the country, with the great valleys of the rivers Gironde and Rhone on either side. It is a favorite region with tourists and with those who enjoy mountain air and mineral water. The attractions are picturesque hills and valleys, quaint towns and old castles, peaks like Mont Dore and Puy-de-Dome (with its twenty-five famous springs), and numerous health resorts, among which is Vichy, and its immense hot springs, whose waters are known the world over. The dairying is influenced by the topography of the country and the comparatively scattered population. Aside from supplying local wants, the chief dairy product is cheese, and this is one of the only two parts of France in which a large cheese is made. This kind is called the Cantal; in shape it is like a cask, or an English cheddar, often 2 feet high and 18 inches in greatest diameter. It is solid, well pressed, but the curd is not cooked and the body is soft and white, like an uncured cheddar. The exterior of these cheese is dressed so as to have a white, chalky appearance; they weigh from 60 to 100 pounds, and are regarded as of second quality in the Paris markets.

Passing still farther south, the department of Aveyron is reached. Here the country is still more mountainous, and very rough, rocky, bleak and unattractive. The high ridges are almost destitute of trees, and but poorly covered with verdure; the valleys are deep, narrow and sparsely settled. Miles can be travelled without seeing a human habitation. Yet all this apparently remote and unfrequented region is

traversed by those wonderful public roads to be found everywhere in France, as substantially built, as smooth and as well kept, although not as wide, as the grand boulevard and riverside drive in New York City. These magnificent highways wind around among the mountains, sometimes pass through them by tunnels, and are carved from the sides of precipitous cliffs, so as to maintain easy grades, and often span deep chasms or cross valleys from mountain to mountain, upon causeways of solid masonry, with long series of lofty arches. This grand public work, as complete when passing a hamlet as when approaching a city like Orleans, commands the admiration of the stranger for the engineering skill displayed, the evident durability of construction, the perfection of finish and maintenance, and the beauty of the numerous bridges and arcades.

Aveyron may also be approached from the south by the Midland Railway, which, from the quaint old city of Cette, on the Mediterranean shore, traverses miles of rocky country filled with vast vineyards, — the town of Narbonne being a great wine-producing centre, — and then climbs and winds through the hills and into a coal and mining district until it enters the desolate country already mentioned. Descending from the carriage of the iron road, as the Frenchman says, at the station of Tournemire, a hamlet only, upon the little stream called Souizon, in a deep valley, one sees clinging to the face of lofty limestone cliffs what looks at a distance much like an ancient cliff town in a canon of Arizona. This is the village of Roquefort, appropriately so called, and which has made its name known throughout the civilized world by the unique variety of cheese, which now, as for many generations, if not centuries, has constituted the sole industry of this little town, and the only *raison-d'être* in that peculiar location.

Following a good highway winding up the face of the mountain from the valley the climb of 2,000 feet is easily made, a pair of horses carrying a strong vehicle and six men at a trot much of the way. Then a snug little town is found, solidly built of stone, upon terraces. It has a fixed population of about 700, temporarily increased to

1,000 in the busy season. The buildings are severely plain, many old, and nearly all have one side attached to the cliff. They are of two, three and sometimes four stories, and most of the houses are but one room in depth, as light and air are available only on one side, overlooking the valley. The rocks tower above the little town, 1,000 or 1,200 feet more, like a lofty rear wall, and the face of the mountain has a crescent shape, with this queer settlement clinging to the deepest part of the concave surface, and with a north-east outlook, so that the village experiences a very short day, and lies in the shadow of the cliffs most of the time. This adds to the sombre, damp and chilly aspect and feeling of the place.

As often occurs in limestone formations, the mountain behind the town is full of fissures, caverns and passages, and through these caves there are strong currents of cool, moist air, and little streams of water. The temperature of these caves is about 45°, decreasing only a few degrees throughout the year. The water flowing from numerous springs, sometimes passing through dwellings or factories, has just about the temperature that is ordinarily recognized as "ice water." These natural caves and their uniform atmospheric conditions explain the location of this unique town. The circumstances appear exactly suited to the slow-curing process and the growth of the blue mold (*Pencilium Glaucum*) which give the characteristics of the famous cheese of Roquefort. Perhaps it would be more correct to say that these local conditions create or make possible the peculiarities of Roquefort cheese. But the important fact must also be taken into account, that this cheese is made from the milk of ewes instead of cows. The milk of sheep contributes additional peculiarities, being especially rich in fat, abundant in casein and having characteristic flavors.

Roquefort is said to have been first settled in the time of Charlemagne. It is certain that cheese was made by many peasants in this region, from sheep's milk, in the early centuries, and carried to the caves of Roquefort to be finished and cured for market. The history of the industry from the eleventh century to the present time seems to be un-

broken and indisputable. Nor has time made great changes in the process of making and the character and quality of the cheese itself. Economies in production have been developed, however. Formerly 3,000 or more peasants, or owners of sheep, made the cheese in as many dairies, scattered over a wide area. These cheeses were taken to Roquefort and cared for by the inhabitants of the little village in an unsystematic way, in the mountain caves of various sizes, numbering altogether perhaps 200. Gradually there has come about a union of the cave owners and managers, until the business of Roquefort is practically controlled by two large companies. Only 4 of the largest of the natural caves are now used, these being supplemented by several ponderous buildings of stone, several stories in height, and which include immense vaults or artificial caves, tier upon tier, to which the air currents from the mountain caverns are admitted by tunnels, in ways which secure some desirable differences in temperature and moisture in different apartments. At the same time, co-operation has been effected in the early stages of manufacture. Dairies (*laiteries*), or, as we should call them, cheese factories, have been built all through the surrounding country, until there are over 100 of these. To them the peasants carry the milk every morning, and the factory work is under the supervision of the Roquefort companies. In many cases the companies buy the milk at the factories, paying from \$1.75 to \$2.60 per 100 pounds, or 16 to 24 cents per gallon, according to the season and consequent solid contents of the milk.

The sheep maintained for this dairy industry are a big-bodied, long-legged, white-faced breed, called the Larzac. Heads, legs and bellies are bare, and the animals yield fleece of medium wool averaging about 5 pounds. Their tails are never cut, and the longer they are, the more the animals are esteemed for milk producers. Lambs are dropped in mid-winter, and the ewes are milked until July or August. The active cheese-making season is thus limited to five or six months, and the rest of the year the sheep recuperate, while the Roquefort caves and villagers are busy curing, packing and shipping cheese. Good flocks of ewes

yield an average of 1 quart of milk a day per head during the season. The cheese product is estimated at 25 to 30 pounds per year to the ewe. The sheep contributing to this Roquefort industry are mainly owned within 50 miles although some of them are double that distance. Altogether, there are at least 500,000 ewes milked every year in this region for the purpose of making cheese.

The Roquefort cheese is quite common in American markets. The details of its manufacture need not be given here. It is usually about 8 inches in diameter and $3\frac{1}{2}$ or 4 inches thick, and weighs 4 pounds or a little more. At the cave a good cheese is worth at least \$1. It generally comes to this country closely wrapped in tin foil. The total annual production of Roquefort proper approximates 12,000,000 pounds, and when I visited the caves, in the month of August, they contained nearly 3,000,000 of these rich, highly prized and high-priced cheeses, in various stages of curing, finish and preparation for market.

The labor of hauling all this cheese from the distant factories, over and through mountains and valleys, up to the town and the caves, and down again to the railway station, is a heavy tax upon the industry, but seems to be regarded as a matter of course. The work is performed with very long-bodied, two-wheeled vehicles and heavy nondescript horses, hitched tandem or tridem. The loads are sometimes very large, and curiously balanced by several hundred weight of stone, hung in chains to different parts of the cart.

From Roquefort in Aveyron, the next move to be made, and the last to study French dairying, will be north-easterly to the Jura Mountain region. In the territory to the east of the old province of Burgogne (Burgundy) were formerly the district or sub-province called the Franche-Comté and the duchy of Savoy. Here are now to be found the departments of Doubs, Jura, L'Ain, Savoy and Upper Savoy. These are all east and a little north from the city of Lyons, and not far west from the Swiss cities of Geneva and Neuchâtel. This region is the seat of activity in the manufacture of Gruyère cheese, and is full of interest not only as to present conditions but as regards the history of associated

dairying. It is essentially a mountain industry; mountain pastures, mountain cattle and a comparatively scattered mountain population contribute to its characteristics. The cattle of the country have been for centuries a large, coarse, red-and-white variety, known by the name of Montbéliarde; this is a regional type, if not a breed, resembling its neighbor the Simmenthal breed of Switzerland.

The most notable feature of the cheese making of the French Jura region is that it has been carried on from a very early period under a well-defined local system of co-operation among the milk producers and cheese makers. It has been claimed and believed that the plan of associated dairying originated in the United States near the middle of the nineteenth century, and was first developed in the form of the co-operative cheese factory. Collectively, the cheese factories and butter factories or creameries of this country have been designated as "the American system." But whatever honor or credit attaches to the origin of this idea and practice of co-operation in dairying, must be surrendered to eastern France. The plan has been known and followed continuously in this mountain region between France and Switzerland for several centuries. It undoubtedly originated in that region, but how long ago no one knows. There exists a historical record of co-operative cheese making in the thirteenth century, in the present department of Doubs, and no document of equal age is known which refers to a like industry in any other country. In the middle of the fourteenth century little associations for cheese making were numerous and active in Upper Jura. In the seventeenth century their number and work were so important in the Franche-Comté as to be the subject of special laws. These associations became well organized and quite numerous two hundred years ago. Examples of the articles of association and of contracts between the society and its several members, as to contributions or sales of milk, and also as to cheese sales, are still preserved, which are two hundred years old or more. It is hardly expedient to further follow here the history of these little factories, or their present organization and operations, interesting as they are.

Although the variety of cheese for which the whole Jura region has been noted is not believed to have been materially changed in character during all these centuries, it has changed its name. It was at first and for some hundreds of years known as *vachelin*. But at the beginning of the nineteenth century, the home supply of cheese was insufficient for France, and importations from Switzerland rapidly increased. The cheese of the French Jura seems to have been "not without honor save in its own country," and that of the Swiss Jura, practically the same thing, became such a favorite in France that its Swiss name of *Gruyère* was adopted as a substitute for *vachelin*, and has been in use ever since.

The name Gruyère comes from a small but very old village in the canton of Fribourg, Switzerland, situated only a few miles north-west from Lake Geneva. This little place was formerly the capital of the county of same name. The castle of the Counts of Gruyère is an ancient one, overlooking the village. They were powerful noblemen, possessing a wide territory, extending from the lake well into the Alps. But the last Count of Gruyère was a profligate and spendthrift, and in the year 1554 the possessions of the family were divided and dispersed, and the title ceased to exist.

The departments of Jura and Doubs lead in this industry, but it is also active in L'Ain, Savoy and Upper Savoy. These five departments produce about 40,000,000 pounds annually, and the same variety is made more or less in at least 30 other departments. The total yearly product of Gruyère cheese in France is therefore 45,000,000 pounds, sold by the makers for over \$5,000,000. The average price for the last five years has been rather more than 11½ cents per pound.

The importance of the dairy industry in eastern France has resulted in the establishment of several institutions in this interest. There are 13 practical schools of cheese making in this region, the most important of which is located at Poligny on the department of Jura. The only national dairy school of France is also in this part of the country, being located at Mamirolle, in the department of Doubs. This is a well-organized establishment, in good hands, and,

although not largely attended, is doing excellent work. General dairy instruction is given, but the specialties of the school are the manufacture of Gruyère and Emmenthal cheese. These two kinds resemble one another closely, and yet there is a distinction. Just as the cheese makers of the French Alps years ago borrowed the former name, under pressure of Swiss competition, so in recent years what may be called an improved Gruyère has come into France from Switzerland, and won an enviable reputation under the name of Emmenthal. Nearly all Swiss cheese imported is now of this variety. To meet this new or renewed competition, the school at Mamirolle is leading in a movement to improve the Gruyère of eastern France, and to adopt the latest Swiss name. The Emmenthal cheese differs from the average Gruyère in these particulars: less cream is taken from the night's milk and the skimming better regulated according to the season, so that the fat content of the milk made into cheese is greater and more uniform. Gruyère is usually made from milk carrying little more than 3 per cent of fat, and often less; milk for Emmenthal should have 3.6 to 3.7 per cent of fat. Of course the cheese produced is richer and better. Very strong rennet is used, prepared with extra care. The separation of the whey is very complete before cooking. The pressing of the cheese is stronger and longer. After pressing there is a brine bath for two days. The curing room is held at a higher temperature, — from 68° to 72° F. The Emmenthal is made considerably larger (170 to 200 pounds), and with more finish. Altogether, it is a Gruyère (or *rachelin*), or Switzer-käse, of high grade.

The facts and conditions described are those of large districts in France where dairying has been for several centuries the principal agricultural industry. In America the dairy industry has been mainly developed within fifty years, and wholly within one century. Comparison shows that there is little for us to learn from the older country. Our cattle are far better adapted to their work, and more economical as dairy animals. As a rule, they are better housed, fed and cared for, with greater economy of labor: yet in many cases French dairymen are skilful feeders, although unscientific.

The rents which are often paid for farms in France would be regarded as impossible in this country ; on the other hand, hired labor for farm and dairy costs but a fraction there of what it does here. In dairy utensils and equipment ours are greatly superior, and our methods are more generally founded upon principles which are understood and known to be correct. Butter is more economically produced in the United States, and, so far as the product of the creamery system is concerned, it is of higher average quality than that of France ; the same cannot be said of the farm dairy butter of this country. France offers a much greater variety of cheese and a much more general appreciation of this product as an article of food. Much of the French cheese is excellent of its kind, yet the facilities and processes of making and curing are comparatively crude. The factory system of cheese making is at present better organized in America, and conducted with greater economy, equal skill and more intelligence. In the important business of making milk for market, and all through the milk service for towns and cities, the United States is far in advance of France. This is true not only in comparing averages, but our best establishments and practices are superior to their best in production, quality, purity, preparation, transportation and delivery.

While too much cannot be said in praise of the industry, frugality and thrift of French dairymen and their families, a close comparison leads one to feel that the conditions of the industry in the United States are decidedly more satisfactory in almost every particular.

[NOTE. — The foregoing text is only half a reproduction of the lecture as delivered, the latter being illustrated by more than one hundred lantern slides, thrown upon a curtain, nearly all being made from photographs collected by Major Alvord during recent visits to the places described.]

Following this lecture was a reception to the Board of Agriculture and others attending the meeting, given by the citizens of Northampton.

SECOND DAY.

The meeting was called to order by First Vice-President Sessions, who said : Time was when I used to raise tobacco, and was somewhat familiar with the business and the men engaged in it, but that time has passed, and, in order that we may get the most out of the discussion which will follow the lecture, I have asked a man more familiar than I am with the men engaged in the raising of tobacco about here to preside, who will know who it is who asks questions of the speaker. I therefore call on Mr. H. C. Comins of this city, a member of this Board, to preside this morning.

The CHAIRMAN. In making arrangements for this meeting, the committee endeavored to select such subjects as would be of interest to the farmers of this locality ; and, while the business of tobacco raising and curing may not be one of special interest to a good many locally, it is one of the chief industries of the Connecticut valley, and one in which our agriculturists are perhaps more interested than in any other crop. We have been trying since the early days of tobacco culture to raise and cure a good article, and we have made some progress. We know pretty well how to fertilize, but there are a great many things that we do not know, and we have invited a gentleman to come here and speak upon this subject this morning. He will give us the latest and most scientific knowledge in regard to the culture and curing of tobacco, and I now have the pleasure of introducing to you Dr. E. H. Jenkins, director of the Connecticut Agricultural Experiment Station.

THE LATEST RESULTS OF EXPERIMENTS IN THE CULTURE, CURE AND FERMENTA- TION OF TOBACCO.

BY DR. E. H. JENKINS.

Raising wrapper-leaf tobacco is an old, established industry in the Connecticut and Housatonic valleys. Partly because of this long practice and the general knowledge which comes with it, farmers in this section are, as a rule, more skilful in growing, curing and handling this particular type of leaf than are the farmers in those places where tobacco growing is of more recent introduction. I am not at all disturbed by the charge that we grow the leaf just as our fathers grew it. That we follow our forebears' practice, in its main lines, is one of the reasons why we make no more failures than we do. The accumulated experience of a generation is a safer thing to follow than the "Lo here," or "Lo there," of some newly born enthusiast.

It is also true that no soil and climate in the United States is known which can produce a leaf more nearly neutral in flavor or more nearly free from objectionable flavor—and in this respect better fitted for a wrapper of highly flavored Havana filler—than our New England climate and our best tobacco soils. Still further, in no part of the world has so much study been given to the fertilization and culture of wrapper-leaf tobacco, and, as a consequence of this, nowhere, I think, is leaf raised which has, on the average, so satisfactory a burning quality as the New England leaf. That New England "Havana" and "broadleaf" sell, or until quite recently have sold, at higher prices than any other domestic wrappers, proves, I think, that the foregoing claims for our leaf are well grounded.

Nevertheless, in the face of these very favorable conditions, we have had for years strong and growing competitors and rivals, — and apparently this competition will become still more active. I do not need to enlarge on this. We all know that the cigar makers of this country are using annually 30,000 bales, or over 5,000,000 pounds, of imported Sumatra leaf, which supplants a great deal more than that amount of our New England wrapper leaf, and that this goes on in the face of an import duty of \$1.85 per pound. We know, too, that several large concerns in Florida are raising excellent wrappers of the Sumatra type, are packing the crop to closely imitate Sumatra, and are selling it freely in New York, from which centre it undoubtedly finds its way to factories which are supposed to handle only imported Sumatra.

But the things we do not know make some of us still more afraid. We do not yet know what Cuba, Porto Rico and the Philippines, with American capital and business methods, can do in producing wrapper leaf, nor on what terms their products will enter our markets a few years hence; nor do we know what effect the concentration of the tobacco trading and manufacturing business in gigantic trusts will have on the business of the grower of the leaf. It is a time of great uncertainty and not a little apprehension. Tobacco worms and hail and drought and pole-burn are not our only enemies. Competition and the manœuvres of the tobacco trusts seem just now the more formidable.

How shall we meet this growing competition? There is a tendency to turn at once to the State or national Legislature, whenever things go hard with us, and see if some new law cannot be devised which will relieve us at some one's expense other than our own. But, whether we approve or disapprove of either the principle or the practical working of such protective legislation, in one thing we all agree, namely, that such protection does not always protect, nor fully protect, and is subject to great fluctuations with changes in the administration. For instance, we are now "protected" in a way against Sumatra and Cuba; but have we any assurance that we shall be "protected" in anything

like the same way by the time our next tobacco crop is cured? I trow not.

There is, I believe, a more excellent way to meet foreign and domestic competition, — one in which the farmer has the chance, at least, to work out his own salvation quite apart from the politician, statesman and economist, and one which crowds no other man unfairly. He can meet it by raising tobacco of better or more acceptable quality in all respects than he has raised before. That is of all the best way, the fairest way and the safest way, and it is a practicable way. The last word has not been spoken about our domestic leaf. We have not done our level best by it yet. We can produce a much better leaf, on the average, through the State than we have yet produced.

We grow tobacco as our fathers grew it, in the main ; but, just as they added of their experience to what was known before, so we are called on, and particularly called on at the present, to add to this New England tobacco tradition such improvements as our own experience has discovered ; and as the demands of the trade change from time to time, our practice must change to meet this. It is not what we think is prime tobacco, but what the trade demands and will pay for, that we must raise. The trade is calling for goods of the Sumatra type. You and I may hold that there is nothing better than a good broadleaf wrapper, and nothing bitterer than a Sumatra leaf. But if the trade wants Sumatra, that it will have ; if not from us, from some one else. We cannot dictate to the trade ; we must satisfy its whims and fads, whatever they are. I say the Sumatra type of leaf is most in demand, — not necessarily leaf grown in the island of Sumatra, nor even grown from seed which came from that island. Judicious plant breeding may yet produce from some other source a leaf equal or superior to the Sumatra type. By the Sumatra type I mean a leaf smaller than the New England Havana, 16 or 18 inches being the most desirable length, light to medium colors, with open grain, free burn, great elasticity or “ life,” and very thin texture. That is what the trade wants to-day, and will have ; and if this demand continues, that is what New England must furnish

to keep her position in the business of tobacco growing. Can we furnish this type of leaf?

In 1900 the Connecticut station, with the co-operation of the Division of Soils of the Department of Agriculture, set about answering this question. A great number of matters were involved; among them, questions of labor, cost of buildings (if new buildings were needed), new knowledge and experience in growing, curing, fermenting and packing the crop. But obviously the first thing to determine was whether, in our soil and climate, Sumatra leaf of good quality could be grown at all. That and no other was what we proposed to determine, and that was all we could hope to determine in one year, with our limited means and experience.

I need not here describe the details of our work in 1900. One-third of an acre was enclosed with a substantial wooden frame, to support a cover of very thin cheese-cloth, 9 feet above the ground, and closed on all sides to the ground with the same material. The soil was fertilized as usual for our domestic leaf, and half the area was set with Sumatra plants and the other half with New England Havana. Both were set much closer than is usual, in rows $3\frac{1}{2}$ feet apart and plants 12 inches apart in the row. Our experiences during the growing season were, in brief, these:—

The cover was a perfect protection against insect pests. Cutworms did some damage to the young plants, but no flying insects preyed on the tobacco. At harvest it was very hard to find a leaf which showed insect bites. The tobacco was also perfectly protected from wind-whipping and from light hail. The temperature under the shade was considerably higher than outside, and fluctuated less. Most noticeable, however, was the way in which the shaded crop was protected from drought. The slightest patter of rain went through the thin cheese-cloth readily, but evaporation from the crop and soil into the air was greatly hindered. The air under the cloth was usually very moist. In July of that year we had a very dry time, when the crop outside on that land stopped growing for a few days, for lack of water. But while the crop outside suffered, that under the shade continued to grow thriftily, and the soil very near the sur-

face was still visibly damp, while outside it was dry and powdery. We have no measure of the amount of sunlight intercepted by the cloth, but the "shade" was scarcely evident to the senses, and the light beneath it was more trying than the clear sun, probably because of the greater heat and humidity. Probably the close planting shaded the leaves much more than the cheese-cloth shaded them.

Two rows each of Havana seed leaf and of Sumatra grown under the shade were topped, rather high. The leaf from the topped plants, however, after curing, was seen to be distinctly inferior to that from the untopped plants. The untopped tobacco of both varieties grew to the cover, 9 feet from the ground, and the Sumatra stalks bent over and grew to a length of 10 or 11 feet.

The occasional wind and rain storms of the summer did no serious damage to the cheese-cloth, except where, through errors in fastening, it chafed badly in the wind. To make repairs required perhaps a day's work of three or four men during the season. After harvest came a very severe wind storm, following the Galveston hurricane, which blew down trees and did considerable damage, but did not injure the cheese-cloth shade at all.

Under the superintendence of Mr. Floyd, the leaves were picked or "primed" when they were thought to be ripe, strung on strings, cured in the usual way, and then fermented in a pile or "bulk." When ready for market, samples were taken from the several primings, except the first, which included only inferior bottom, or sand, leaves. The samples consisted of a number of hands taken at random, and each hand was a single string of leaves just as it was strung by the girls, and therefore represented the general run of the leaves, and not a selection. I may say here that after taking samples this little broken lot of Sumatra leaf, from only one-sixth of an acre, sold for 71 cents a pound. The samples were sent to a number of the leading dealers and manufacturers in the country, with the request to examine carefully and give opinion of the quality of the leaf, and to state fully its defects also. Let us notice briefly their replies:—

Mr. Walter G. Wilson, secretary of the Philadelphia Cigar Leaf Tobacco Board of Trade, said : —

The samples of tobacco grown in Connecticut, especially of wrapper leaf, have been submitted to our board, and we are unanimously of the opinion that both in the Sumatra and domestic grades that were produced these were the finest ever seen. The Sumatra style, especially, was submitted to actual tests for burn, yield and colors, and in every case far excelled the imported article, while in the domestic grades the goods raised under government direction were far above the best of those produced in the ordinary way.

I took personally the Sumatra end of the string, and gave several hands to one of the largest cigar manufacturing firms in the city of Philadelphia, and had them use them in the regular way to make up their cigars as made regularly. They brought them over to me, and upon inquiry they pronounced it, as Mr. Cullman has said, superior to (imported) Sumatra tobacco, both in color, yield and burn. The only criticism that might be made was that some was a little green. The color had not been set, and it was right out of the fermenting, but that would be remedied by simply a little more time.

Mr. Joseph F. Cullman, president of the New York Tobacco Board of Trade, also stated that the samples of the Sumatra leaf, grown under shade at Poquonock, were, in his opinion, superior to the average imported Sumatra.

Powell & Goldstein, to whom samples had been sent, wrote : —

ONEIDA, N. Y., Jan. 2, 1901.
MESSRS. SUTTER BROTHERS, *New York*.

GENTLEMEN : — We have received the samples and have carefully examined the same, and are more than pleased with the Sumatra seed, as it is far superior in every way to the Habana seed, of which you sent us samples. The leaf is much tougher, thinner, finer grain; the burn is excellent, and the tobacco shows good quality. We think the tobacco is an exact counterpart of the Sumatra grown on the Sumatra Islands, and we believe, if these experiments would be continued by the government, still better results could be obtained. We thank you very kindly for submitting the samples to us, as we are always trying to learn all we can in regard to any improvements in tobaccos that are coming up.

Yours respectfully,

POWELL & GOLDSTEIN.

Kraus & Co. wrote :—

BALTIMORE, Jan. 5, 1901.

MESSES. SUTTER BROTHERS, *New York*.

GENTLEMEN :—As regards the Sumatra seed, the sample indicates a tobacco of considerable merit, and compares very favorably with the genuine imported Sumatra. The sample, however, owing to its immature condition, being deficient in curing, does not work up as well as would be the case were the tobacco in perfect condition, the colors being as yet unsettled, and therefore, in the condition as received, does not come up in appearance to the genuine Sumatra. This defect, however, can of course be easily remedied by giving the tobacco the proper attention. As regards the yield and smoking qualities, we consider same of very superior merit. We consider there is a very large field for the development of this tobacco in this country, and, if conducted on a commensurate scale, would ultimately make the manufacturer independent of foreign Sumatra leaf. We will be glad to render you any service in our power in promoting this matter, and remain,

Yours very truly,

KRAUS & Co.,

Per KRAUS.

In reply to an inquiry of the writer, the following letter was received from the New York house of Sutter Brothers :—

NEW YORK, Jan. 17, 1901.

MR. EDWARD H. JENKINS, *New Haven*.

DEAR SIR :—We are in receipt of your favor of the 15th inst., and in reply would say that we submitted the tobacco to about four or five of our largest customers who have been working Sumatra and Havana seed, and all their reports are in favor of the experiment. They claim that the goods are much finer than anything they have ever seen, and call our especial attention to the Sumatra seed as being as fine in every particular as the imported article. Our customers' letters were very encouraging indeed, and they all express the wish that the experiment be continued, as it would be for the benefit of all concerned, especially to the dealers and manufacturers, and of course to the smoking public at large. We certainly trust that the experiment will be continued next year, and if there is anything we can do to advance same, we are at your disposal.

Yours respectfully,

SUTTER BROTHERS.

These reports, from men who are in touch with the present condition and requirements of the tobacco trade, and

who had no personal interest in the crop, settle beyond dispute the quality of the Sumatra tobacco which we raised.

The experiment made at Poquonock in 1900 by our station, with the help of Professor Whitney and Mr. Floyd of the United States Department of Agriculture, has therefore demonstrated, without a shadow of doubt, that Sumatra leaf of excellent quality can be raised under the conditions of soil and climate which prevail in New England. There has been a great deal of useless talk about this experiment, for which, of course, we are not responsible. Our position, which we have clearly stated in giving the results of our work, was this : —

To determine whether Sumatra leaf of good quality could be produced in this State was the object, and the *only* object, of this experiment. It remains to be seen whether such tobacco can be *economically* raised in Connecticut, — raised on a considerable scale, *at a profit*. To determine these points will probably require some years of experiment. We would strongly urge farmers not to undertake to raise Sumatra tobacco under shade at present, in anything more than a very small way, and purely as an experiment, which will not seriously cripple them, even if it is a complete failure.

Encouraged by the outcome of our experiment in 1900, quite a number of growers have taken up the matter, and this year over 50 acres of Sumatra have been grown under cheese-cloth shade in Massachusetts and Connecticut, most of it with the general superintendence and advice of experts in the employ of the United States Department of Agriculture. The largest investors in the business have been the Mitchelson Brothers of Tariffville, who have had, I believe, something more than 18 acres under shade. Already much of the shaded leaf has been fermented and sorted. At present the outlook is extremely satisfactory, and high and paying prices are anticipated.

But the historian's trade is safer than the prophet's. Let me, therefore, tell briefly what the station has done in the present year : for we have gathered some experience in the business, and I think the outlook is sufficiently promising to

make any observation and experience in the matter valuable. A final judgment on our experiments in 1901 cannot be given till our crops have been fermented and sold.

This year we extended our frame and shade to cover a little more than an acre. About harvest time we measured very carefully the land on which tobacco grew, including half the width of a row on each side of the plot and half the distance between plants on each end of the plot, and found we had .93 of an acre under tobacco; but all the figures I shall give hereafter are calculated to just one acre.

The rows were 3 feet 3 inches apart and the plants 14 inches apart, giving about 11,290 plants to the acre, — nearly 3,000 more per acre than with our usual planting.

I need not give in detail here the method of building our frame, though I have the figures with me, if they are desired. It is probably as heavy and durable as any that has been put up this year, and more expensive than most, for all the material was bought at the nearest lumber yard, none of it being got from our own woodland.

| | |
|---|----------------|
| The cheese-cloth for an acre cost | \$162 94 |
| To put it on cost | 12 45 |
| Lath used in fastening the cloth, | 13 17 |
| The framework, including wire, lath, nails and labor, cost \$304.95, of which there should be charged to the crop 20 per cent,—a liberal estimate, assuming that the whole will be abandoned in five years, | 61 00 |
| Total. | <hr/> \$249 56 |

That is, our special outlay at planting time was about \$495 per acre, of which about half, \$250, should be charged to the first crop, the remainder to investment, subject to an annual deterioration of 20 per cent. To this must be added the expense of setting 3,000 extra plants to the acre and the extra cost of setting by hand, for machine planting under shade and at 14 inches distance was not practicable. These items I cannot closely estimate. The cost of fertilizers and of cultivation is the same under shade and outside: the cost of shaping the land is a little greater under the shade. I do not think the cost of picking the leaves, bringing them to

the barn and hanging them, after stringing, is any greater than that of cutting, teaming and hanging the plants harvested in the usual way.

The plants from an acre of tobacco weigh, as carried in, 18,500 pounds, of which 9,500 pounds ($4\frac{3}{4}$ tons) are stalks. But when the leaves are picked, these $4\frac{3}{4}$ tons of stalks stay in the field, instead of being carefully handled and lifted into place in the barn. Only about a fifth of our tobacco was primed, the rest being cured on the stalk, and the work was done by incompetent child labor, as it did not pay, with so little to be done, to make an effort to get effective labor. With 22 leaves to the plant and 40 leaves to a lath, there would be required 6,200 lath to the acre. At the rate paid to effective labor at Tariffville, viz., 20 cents for stringing 25 lath, the approximate expense of stringing would have been \$49.80 per acre. The prices named would give the girls wages of from \$1.35 to \$2 per day. An acre of tobacco, hung in the usual way, requires about 1,300 lath; when the leaves are strung separately, as in our experiment, about 6,200 are needed. The whole cost of the extra 5,000 lath should not be charged to one crop. I think 20 per cent of it, or \$5.39, might fairly be so charged.

Regarding the space required for hanging: allowing 8 inches between lath when tobacco is hung on the stalk, and 5 inches when the leaves only are hung, 858 running feet of hanging poles are needed in the former case, and 2,052 in the latter; but, since two tiers of leaves can be hung where only one of stalks can hang, the disproportion is much less, that is, an acre of primed tobacco takes up as much room in the barn as 1.2 or 1.3 acres of tobacco hung on the stalk. But where there is a considerable acreage of tobacco, as there was at Tariffville, and the harvesting lasts over a period of five or six weeks, two lots of tobacco can be cured in the same barn, the first harvesting being cured and taken down by the time the last harvesting is ready to go in.

Now, when it is time to take down and strip, the advantage is very greatly with the primed leaf. The string can be cut at each end, wound around the butts, thus making a

hand of it, and the hands bundled, or the leaves can be drawn from the string and bundled loose. Stripping and bundling can be done much more quickly, easily and neatly when the leaves are primed. The danger of getting the leaf out of condition or bruised is also much less.

Now, as to yield. We got at the rate of 1,258 pounds of primed Sumatra per acre in the bundle, — less, by 250 pounds, than last year, when we planted two inches closer in the row. To summarize: —

| | |
|-----------------------------------|----------|
| The shading cost | \$249 56 |
| Stringing the leaf, | 49 80 |
| Extra lath for hanging, | 5 39 |
| <hr/> | |
| Total, | \$304 75 |

To which we must add the extra cost of setting the piece, extra barn room, extra labor and some little fuel (lanterns), on the seed beds.

Now, we are not getting rich very fast on 25 cents a pound for our New England Havana, with 1,800 pounds to the acre, or \$450 gross receipts per acre. If we raise 1,250 pounds of Sumatra leaf instead, we must get 37½ cents a pound for it in the bundle to meet the ordinary expenses, and more than 25 cents per pound to meet the extra expenses of the new method of growing and harvesting, — yes, very considerably more, to offset the risks and uncertainties of a new method of doing business.

I have given you as full a statement and as fair a one as I can. The one vital point I have not yet touched, — what will New-England-grown Sumatra leaf bring in the market? Ours is not yet sold, and must always be sold at a disadvantage, because it is such a small lot. It is not a “packing,” as dealers say. But this winter or the following spring it is likely that some considerable lots of this New England Sumatra, fermented, sorted and baled, will be sold to experienced dealers, and that the prices will be made public. If so, we shall know what money value experienced dealers put on the finished leaf nearly ready for manufacture, — not, be it remembered, on the leaf in the bundle as it leaves the farm. It is to be hoped that we may also learn, from

the government officials in charge, the cost of fermenting, sorting and baling, without which, of course, the figures of the final sale would have little meaning or value to the grower.

I ought to say that the crops, so far as I have examined them, are, it seems to me, very fine, and I see no reason why they should not sell for as much, if not more, than the imported Sumatra. Dealers and manufacturers who have seen these crops say the same. But, after all, the real test of opinion is when dealers come and offer good money in exchange for the leaf, and when manufacturers who have worked the leaf and sold the cigars made from them come and ask for more.

It needs to be said here that no one can sit down with pencil and paper and make profits on growing tobacco. He can figure them and imagine them; he can show how a profit would result if a dozen different things went as he assumed they would, but they never do. I shall doubtless be reported as saying that it costs the farmer a little over 37 cents a pound on his crop to raise it under shade rather than in the open, and that what he gets for it above 62 cents a pound is profit, and if he gets less he loses. But I say nothing of the kind. One year he may make money, selling at 62 cents, the next he may lose, selling at \$1.50 or \$2 for sound leaf. For instance, we had a squall at Poquonock last year, which lasted five or ten minutes, and in that time added a cent and a half a pound to the cost of production of our crop by the damage it did to the shade. It was the worst squall known there in fifteen years, uprooting trees and blowing down some barns. If there had been heavy hail with it, the thing would very likely have been ruined.

Now, the man who makes money with a paper and pencil cannot tell whether that will happen next year; or whether a late freeze will half ruin our seed beds; or whether heavy hail will break through our shade; or whether a drought will spoil the quality even of the leaf grown under shade; or whether we can get, just when we need it, the extra labor for harvest. For these reasons it seems to me foolish

to make a formal statement of what it costs to raise tobacco in this way or that way. I have given you a statement of the principal items of expense made necessary by the shade, which we encountered this year. You know very well that such a statement is valuable, and you know the limitations of its value.

The priming and stringing of tobacco is a thing to which we are quite unused, therefore its difficulties are apt to be exaggerated; and yet, under our conditions, it certainly involves considerable expense, besides the difficulty in getting the right kind of help when needed. We therefore tried the experiment of harvesting a part of our shade-grown leaf on the stalk. We cannot learn the effect of this on the quality of the leaf until the fermentation is finished, but we are convinced that in using this method a considerable damage to the leaves is unavoidable. Each stalk was cut in two in the middle, the upper halves being hung on hooks, ten to a lath, the lower halves, six to the lath. A considerable percentage of this leaf is more or less torn, while it is hard to find a single hole or tear in the leaf which was cured on the string.

To decide when the leaf is ripe and ready to prime is the most difficult problem in the growing of shaded tobacco. It is not possible to give very clear instructions regarding it; experience is the only teacher. But I believe the tendency is to pick it before it is fully ripe, and there is generally more danger of erring in this way than of letting the leaf get over-ripe. The shading off to a lighter green, a yellow tinge on and near the tip, darker green spots on the leaf surface, a slight puckering of the leaf, are all signs of ripeness.

It is not wise to cure primed leaves in the same barn with tobacco hung on the stalk. We have been forced to do it, and have done it very successfully, but only with very special care and great inconvenience. The primed leaves dry out much more rapidly, and are much more likely to "hay down" than leaves on the stalk; and the barn must be managed with this in mind. When partly cured, it is often an advantage to close up the lath so the leaves nearly touch, to check too rapid drying.

Although others have repeatedly tried raising Sumatra tobacco in the open, with very indifferent results, we have made the same experiment this year, setting the plants at the same distance as under the shade. We defer judgment on this test until we have the finished leaf to examine, but we do not anticipate any remarkable success from this method.

We also raised under shade about forty plants each of Connecticut broad-leaf and of New England Havana. While I doubt if it will ever pay as a business proposition, to do this on a commercial scale, the pole-cured leaf, for grain, color and finish, was certainly superior to anything we had ever seen in the shape of domestic tobacco.

In conclusion, our observations in 1901 leave us with more confidence in the possibility of raising the Sumatra type of tobacco in New England at a profit than we had a year ago. It has not been demonstrated. It cannot be fully determined until this year's crop has been sold, manufactured and smoked. Producer, middleman, cigar maker and cigar smoker must all be satisfied. But I now consider it probable that some growers can raise the Sumatra type of leaf at a greater profit than the domestic type. I advise no one to go into the business at all extensively, but I advise all successful tobacco growers to consider it, and, if they have a sufficient capital to justify a business venture, to try raising at least a small patch under shade.

I must pass on now to speak of another matter, — the fermentation of wrapper-leaf tobacco. Perhaps it does not interest growers of tobacco so much as it interests dealers, although I believe the number of those who ease down and ferment their own crops is increasing, and at times it is certainly an advantage to do it.

Trade and crop conditions within the last few years have been such that it was often very desirable to get the new crop into market at the earliest possible date. The trade would not or could not wait for the customary sweating process, which took from five to eight months; so a method of "forced sweating" was practised, which got the tobacco into market in less than two months from the start, and in

fairly satisfactory shape. In substance, this method consists in packing the leaf in cases in the usual way, and putting them in a room which is kept very warm and very damp. There is little agreement as to the proper temperature, some keeping it at 90° or 95° F., others keeping it as high as 130°. This method seems to hold the light colors of the goods, it gives the leaf the look of sweated tobacco, and damage in the case is not common. The tobacco has a peculiar, sweetish smell, however, which gradually disappears on aging; and it is not, in the opinion of dealers, so good an article as the same leaf which has been fermented by the old process, which is often called the "natural sweat."

Three years ago I fermented our experimental crop by still another method, which is used in Cuba, Florida, Germany and Sumatra, but which had not been used commonly, if at all, with our New England wrapper leaf. To distinguish it from the others it may be called fermentation in bulk, though it is as "natural" and as little "forced" as the old standard method. The test was so successful that we have sweated our crops of the last two years in bulk, and our 1901 crop of Sumatra will be put in bulk in a few days. This method is, I believe, destined to largely supersede the others, for reasons which I will presently give.

What is the fermentation, the "natural sweat" of tobacco? So far as we know at present, it is this: Cured tobacco leaves normally contain two or more ferments,—chemical agents which, though present in very small amount, can excite extensive chemical change in the leaf, just as a very little rennet can curdle a large amount of milk, or as malt can turn many hundred times its weight of starch into sugar. It is these chemical substances in tobacco which carry on the fermentation, and not at all the bacteria, to whose action the whole thing was formerly ascribed.

Now, these ferments in the cold, or in the dry, leaf will not act at all. Tobacco must be "in case," containing 25 to 30 per cent of water, and must be warm, before any true fermentation can begin. Once begun, the heat rises rapidly, for certain matters in the leaf, through the agency of the

ferments, oxidize, and liberate heat in so doing. So great is this heat that a bulk of wrapper leaf, left to itself, might be damaged or ruined by cooking. Heavy filler leaf sometimes reaches a temperature of 150° F. in the bulk, while at that heat wrappers would be injured.

Now, in whichever way we sweat the leaf, the process is as I have described, but the result depends upon the skill with which it is done. It is possible to undersweat or oversweat the leaf, or to sweat it unevenly. Molds may get in and cause mustiness; bacteria may attack and rot or "canker" the packing.

By the commonly used "natural sweat" process the tobacco is tightly packed in cases during winter and early spring, and put away in unheated store-rooms, where it lies until the turning of the season warms it enough to start the ferments, and then the processes of fermenting and aging go on together.

No method is better than this, when it goes right. The trouble is that it often goes wrong. When the tobacco lies dormant, before fermentation begins, molds may attack and damage it. Sometimes you can detect this trouble in spring, before fermentation begins, by the smell of the warehouse room, but there is no chance of doing anything to check it. If it is in high "case," very damp, that is, when it is packed, canker and rot may injure or ruin it. In any event the tobacco is unevenly sweated, that on the outside being often resweat by the cigar maker before he can work it.

Most of these troubles are avoided by fermenting in bulk. The process, in brief, is this: The tobacco, in hands, is piled on a platform raised a few inches from the floor, and which may be covered with fermenting trash tobacco, to give bottom heat. The platform is 5 feet wide, and as long as necessary to make the bulk about 6 feet high. The leaves are laid smoothly in rows, butts out, shingle fashion, the butts of one row lying on the middle of the leaves of the next row towards the side. The workmen stand at the sides of the bulk, no heavy pressure being put on it. Thermometers are put inside the bulk, and when it is built up, the whole is covered, top and sides, with woolen blankets, on

which rubber blankets are laid. The air of the room is kept quite damp, and at a temperature between 70° and 80° day and night. The bulk at once goes into fermentation, the temperature of the tobacco rising from 6° to 10° every twenty-four hours. When it has reached 115° to 125° , or when, for any other reason, it seems best, the whole is taken up, shaken out lightly and rebulked close by. The hands which were on top in the first pile go at the bottom of the second, and those which were outside before, go inside now. If any part of the pile appears at all soggy or too wet, it can be shaken out and dried off a little before being put back; if any tobacco is rather dry, it can be sandwiched in with damper leaf, and at all times the owner can see just what is going on, with a chance to correct what is wrong. This time the temperature rises more slowly, and it may be ten days before the bulk must be again turned over. In most cases the second turning suffices, and the temperature begins to fall, showing that the fermentation is complete. At the end of six weeks the tobacco is ready to be sorted, or cased for sale without further sorting. It must, however, be allowed to stand in a warm place until it has cooled off sufficiently. It may have, in this condition, a slight sweetish smell, which wholly goes as the tobacco ages.

This method, or some slight modification of it, I am convinced will in time replace very largely both the old-time "natural" sweat and the "forced" sweat in cases, for the reasons already given, — that the whole packing and every part of the leaf from tip to butt is evenly finished, giving more even colors than can be got in any other way; and the whole process can be watched constantly, giving a chance to check any trouble which, unchecked, would do great damage. After tobacco has been fermented, it is much less likely to damage in the case than it was before.

One thing more. No tobacco is at its best as soon as it is fermented. It needs to stand for months in a moderately warm place, and age or "mull," to bring out its finest quality and remove a certain rawness or harshness. What happens to it during this time no one knows, but as to the fact of improvement by aging, I believe there is no question.

These two matters which I have discussed this morning cover, I think, the latest results of experiments with tobacco which are of special interest to growers.

We do not anticipate any sudden revolution in the settled methods of raising, curing, or fermenting cigar wrapper leaf, nor is it desirable or necessary that there should be. Good, sound, well-handled New England Havana and broad-leaf will not be banished from the market at once. The fashion in tobacco may change. But if the trade insists on leaf of the Sumatra type, and if it becomes evident that our domestic type of leaf cannot maintain itself in the market at paying prices, we shall know, very much better than we did two years ago, which way to turn.

EX-GOVERNOR HOARD. I understood the lecturer to say that the curing agent in the tobacco was not bacterial, but a chemical ferment. Is that somewhat allied in its character to the enzymic forces at work in curing cheese?

DR. JENKINS. It is precisely the same in its character.

EX-GOVERNOR HOARD. You seem to strike a difference. You must have a certain degree of heat to have the enzymes work in tobacco, whereas in cheese they work at a very low temperature.

DR. JENKINS. Yes, that is true. Of course there are a very large number of enzymes that have been already isolated, and there must be a great many more that we know nothing about. The conditions in which they work are very different. Some work in a very low temperature, others at a much higher temperature; some are killed by heat, a very moderate heat, blood heat, while others need a very much higher heat to sustain their activity. The general word "enzyme" covers a large number of these different chemical ferments, which have different properties, like the saliva of the salivary gland, which converts starch into sugar, or the pepsin, which alters the nitrogenous bodies in food.

EX-GOVERNOR HOARD. I do not quite understand the process of stringing. You describe, if I understand, strings fastened to lath?

DR. JENKINS. You take these lath and notch them at

each end, — I think that is the better way, — and then have a string about six or eight inches longer than the lath, knot it at one end, — draw it through the notch at one end. A man goes through the field and takes off the three or four bottom leaves, and lays them carefully in a long clothes-basket, laying them flat, and when the basket is full it is brought to the barn, — brought on wagons, if they are working on a large scale. This basket also has a piece of burlap sewed on each side, so that the leaf can be placed in the centre of the basket and the burlap turned over it. These baskets are placed on tables, and a single lath lies on the table with the string fastened at one end of the lath, and the needle, a sailor's needle, straightened, threaded with the string. The girl takes the leaves and spears them through the midrib of the leaf. She puts them on face to face and back to back, not all in one direction, but faces together and backs together, so that when they begin to curl up and dry they cannot mat together. She strings the leaf in this manner, leaving the second one about a finger's breadth away from the first one, until she has strung it full, — thirty-five or forty leaves. When she has done that she unthreads her needle and draws the string tight, and puts it through the notch in the other end of the lath and knots it around. You have to leave that string so it is slightly bowing, and the leaves hang equally distant apart, and it is carried off and put up on the poles of the bent.

Ex-Governor HOARD. There is a certain space left at the end?

Dr. JENKINS. Yes, at each end of the lath, three or four or five inches, where the lath rests on the hanging pole.

QUESTION. At one place I noticed that they strung it through on a wire six or eight feet long, fastened to the pole at each end.

Dr. JENKINS. Yes, that is also done. They take the wire and carry it to the place they want it, and fasten it by the ends. The advantage of stringing on lath is, I should think, that the tobacco would be more easily handled if you wanted to take it down or move it a little.

Mr. A. M. LYMAN (of Montague). After cutting, how much is it allowed to wilt before the leaves are stripped

from the stalks? In harvesting tobacco, some of us think it best not to allow it to wilt too much, if we can get it up without bruising it, and that it is more likely to be sound tobacco and less likely to pole-sweat if not over-wilted.

Dr. JENKINS. Where we string the leaves we do not cut the stalks at all. The men go through the rows with baskets, and pick off from the standing stalk three or four of the bottom leaves. At first they have to crawl along, bend down, because the top is thick, so as not to bruise it, and they back along the row with the basket in front, get down between the rows and pick the leaves off, and they keep backing. That is better than going forward, does not seem to do so much damage. They lay the leaves in the basket, and they are brought to the barn without wilting at all. I supposed it would be a disadvantage to have them fresh, because they would break more, but they did not seem to break as I should think they would. A little wilting would not hurt them, but I would rather have them only slightly wilted.

Mr. LYMAN. I thought tobacco was cured better if pretty fresh.

Dr. JENKINS. Yes, we have sometimes had tobacco lie in a basket over night, but it did not do it any good. It warmed it a little in the night, so, afterwards, if we had to keep it over night, we spread it to avoid heating.

Mr. LYMAN. I should like to inquire of Dr. Jenkins, or the audience, if they ever had any experience with what I should call feather-leaf tobacco — a narrow leaf, with a very stiff stem, a thick leaf from the stem out, and a sucker that grows between the leaves which will be very fine. It is something new to me. I should like to know what it is. [A specimen was shown.]

Dr. JENKINS. I have never seen the thing before. This just grows into shoe strings. Have others in the audience had tobacco like this?

Mr. DEXTER HAGER (of South Deerfield). Thirty years ago I was at work for my father, and tore down an old barn that had been used as a stock barn many years, possibly one hundred years; and after clearing out what was there

as fertilizer to put on the land, tobacco was set on the old barnyard, or what had been occupied as the stable, and the only plants on that plot of ground that year were of that description. I have occasionally seen one or two plants of that in a field where the rest of it was of ordinary growth.

MR. H. C. RUSSELL (of North Hadley). About forty-five years ago my father sent his boys over the river to buy some tobacco plants, and I went over with my brother, and we bought a bed of plants of a tobacco farmer, and brought them home and set four rows in a field that was prepared for tobacco in the usual way for those days, and then we continued setting the field with our own plants. Those four rows of tobacco, almost every plant was like the sample on the table, and in the row where we commenced with our own raising there was not a plant. We never could determine the cause. I think it is something that cannot be explained, like many other things in the growing of tobacco. We obtain certain results from certain causes one year, and the next year we obtain similar results from some cause entirely different.

I would like to ask Dr. Jenkins with reference to one point. A good many years ago it was the universal practice for farmers to hang tobacco with twine. Later the system of using lath was tried and adopted by a great many, and objection was made to that system for the reason that it split the stalk of the tobacco, and the tobacco cured much quicker, which was generally thought to be detrimental to the quality of the leaf. But still later, at the present time, here we have the system of picking the leaves off the stalk entirely, and stringing the leaf. Now, the question arises, whether tobacco can be cured too quickly, so as to injure the quality of the leaf. There is another system which has been experimented with some, and that is forced curing, with heat. The question is quite important to farmers, whether this manner of curing the leaf is detrimental to the quality.

DR. JENKINS. Well, now, with regard to curing on the stalk by those two methods, I think it is unquestionable that anything which opens the stalk or gives it a chance to dry, or that partially kills the stalk, will hasten the ripening of

the leaf itself. All of us probably know how much more rapidly spotted tobacco will cure; and where the stalk is split, it will cure more rapidly than where the stalk was hung with twine; and, as I said, where the leaves are picked, the drying out is much more rapid than by the old methods. Curing is not drying down tobacco. We can dry tobacco in a few hours, with artificial heat, and ruin it. The drying has got to go slowly enough so that the chemical changes can take place. It has got to come to the color; and if you dry it to a certain point before it comes to the color, the leaf is gone, not good for anything. It has to turn first yellow, and then brown, and come completely to color while still pretty damp. Now, that can be hastened by the use of artificial heat, without damage to the quality of the tobacco, if it is done right; but artificial heat in a tobacco barn is an edged tool, and much more likely to do harm than good. We have cured two crops with artificial heat, cured them right, and we have known of other tobacco dealers that had a most excellent quality; but we had to be very careful that the heat was damp heat and not dry heat, and we stopped it at times and let the tobacco draw, or we should have hayed it down. The theory of priming the leaf, you take the leaf when it is perfect, when it needs to draw nothing from the stalk and to give nothing to the stalk, the stalk can do it no more good; take it off and hang it by itself, and cure it as it should be cured, give it time to come to color, and you have a perfect leaf. I think tobacco can be cured on the string as well as on the stalk, and give tobacco of just as good quality, if it is done right.

EX-GOVERNOR HOARD. You find that depends very much upon its stage of ripeness?

DR. JENKINS. Yes, sir.

EX-GOVERNOR HOARD. They commence to ripen at the bottom first?

DR. JENKINS. Yes.

EX-GOVERNOR HOARD. You then repeat the picking in proportion to its stage of ripeness?

DR. JENKINS. We repeat the picking in proportion to its

stage of ripeness, take each leaf when it is exactly right. By the other method we would cut the stalk when of average ripeness, the bottom leaves overripe and the top leaves unripe, and the prime wrappers come from the middle of the leaf. The theory of priming is to take each leaf when it is ripe. When you take off the bottom leaves, the next can ripen, and so on until finally you get everything up to the top leaf ripe. They claim at Tariffville that every leaf is a wrapper, — that they haven't any binders or fillers. We meet with this objection. People say, "We have saved leaves, have cut them off the stem and hung them up in the barn, and they never amounted to anything." Well, they were sick leaves, that dropped off because there was some out about them, and they were hung up most any way in the barn, — not hung with sufficient care.

MR. RUSSELL. Whether there is any effort made to retard the curing of these leaves strung on strings?

DR. JENKINS. Oh, yes; you have to watch the barn.

MR. RUSSELL. Whether you allow the leaves to cure as fast as the natural air will cure them?

DR. JENKINS. No. It depends on the air, but under ordinary conditions you have to keep the barn closed some daytimes and open more at night. You have to protect the primed leaf from dry winds that wouldn't do very much damage to leaf curing on the stalk. In Sumatra, where it is more damp, the rule is to dry it out once a day and let it draw once a day, drying it down as dry as they can, and then letting it draw and get very damp again.

MR. RUSSELL. Do you recommend that plan among farmers, hanging in the old way, with the leaves remaining on the stalk?

DR. JENKINS. Why, yes; sometimes hold it back. That is a matter of judgment. I do not think we pay enough attention to our tobacco barns during the curing. A great many get the tobacco in, and then feel that the work is done, and go to the horse races. That is just the time trouble begins, — when the tobacco is hanging in the barns; and it has got to be watched every minute until it is cured and ready to take down. There is never a day that it isn't

in danger of some trouble or other. Either it cures down too quickly or fulls up when it first goes in, and you can't get the air through, and you have got to look out for pole-burn.

Mr. RUSSELL. One more question. There are a great many farmers here to-day, — tobacco farmers who want to get a little information on the steaming process. Providence isn't helping us to any damp weather these days. Farmers want to know if you can give them any information on that subject.

Dr. JENKINS. Well, as a result of my early religious education, I should say a steam boiler was a poor substitute for a wise Providence, anywhere; still, if you can't have Providence, you have got to have steam, I suppose. I have had no experience with steaming tobacco in the shed to get it into case to take down. I have had some experience with casing in the sorting room, where we were getting ready to ferment the tobacco, and wanted to keep the tobacco in case while lying in the room, and there I have never been satisfied with dry steam running into the room. It will get the tobacco into case, but you shut it off, and it is gone. Tobacco doesn't hold the moisture it has got, as it does when water vapor or wet steam is used. It seems to bring it into case superficially, and then it dries out more readily. In the sorting room, of course, where you are packing down tobacco, the ideal way for getting moisture is to run steam into barrels of water, and bring the water to the boiling point, and there you have what an engineer would call wet steam. If you are going to run a locomotive or stationary engine, you have to have dry steam, so you won't have water vapor to blow out the cylinder head; but here with tobacco the ideal thing would be a fine spray, and the nearest you can come to that is wet steam, — steam coming from the surface of boiling water.

There is one more thing I want to say with regard to pole-sweat. None of us here have any pole-sweat in our own barns, but all our neighbors have got it, and we know it.

Mr. RUSSELL. That is just so here.

Dr. JENKINS. In Poquonock there is none in our own

barn, but we know that the fellow over across the road has got it, for we have smelled it and he has smelled it ; but he won't say so, and when his tobacco comes down there is going to be trouble. I saw something this year of drying out barns with fire. We worked some years ago with a system of hot-air flues in our barn, to see if we couldn't dry out the barns with warm air, and it proved ineffectual. It would hold the bottom tier, but it simply lifted the difficulty one or two tiers, and there was the bad air around the second and third tier. This year we were threatened with pole-sweat ; we didn't have any, but we were threatened with it, and I saw one man who saved his tobacco, that undoubtedly would have gone all to pieces, with a wood fire. It was a long, two-hundred-foot barn. He went into the barn and took out the first tier on the left-hand side, the bottom tier and a little from the next tier above, and built up a hard-wood fire there. Then on the next bent the other side of the barn he did the same, and so alternately, first on one side and then on the other side of the barn all through. Then he lighted his fires. It was damp, muggy weather. He had some open land around his whole barn, and he let everything swing clear. It looked like a ham house. The smoke was coming out through the shingles and everything. It looked like a mess, but he let those fires go with everything open until the smoke had nearly gone, and this hard wood was a bed of live coals. Then he closed everything tight, and there was a tremendous amount of moisture, everything almost dripped, because the heat had started the water out of his leaf, and everything then of course was in proper shape for pole-burn. After doing that for an hour or two, he opened it up again, and the wind and the heat made a tremendous circulation and swept the barn out clean. He let it be an hour or more, and shut it up again and gave it another steaming, squeezed the water out more, and then opened it again, and in twelve hours his barn was as sweet as a nut, and any present danger of pole-burn was gone. They did the same thing, practically, in Tariffville. They had the primed tobacco. Of course there was not the same danger as with tobacco hung on the stalk, but they

were going to get it if they didn't look out. They kindled soft-wood fires. They thought the smoke from soft wood was less acrid, and would not taint the tobacco so much. I don't believe it. I think that is a tradition from Florida. They kindled the fires and worked in it the same way, and it dried out the tobacco so it was safe.

The question is, whether they are going to know that smoke when the tobacco is sold. I saw the tobacco in the sweat, after it had come out, and I couldn't detect the slightest odor of smoke about it. I have known of crops, in past years, in Connecticut, dried in that way, and when they came to sell them there was a nasty odor of smoke about them which damaged the sale of the tobacco; but it remains to be seen whether there will be about this, but so far as I have seen any of it, it has been sweet. I think if you can kindle the fires and have the barn open while the fires are started, and then close it up after it has come to coals, it will save the tobacco.

MR. RUSSELL. I should think charcoal fires would be good.

DR. JENKINS. I should think so, but you find men in Connecticut who say that is the worst thing for tainting tobacco. I don't see why it should be. But whatever you use, you must have a big fire, tremendous heat. Here is a barn two hundred feet long and sixteen feet high, and it takes a big lot of air to heat it. Don't skimp on the amount of fire.

MR. LYMAN. Do you suppose all tobacco growers know the shade of color of leaf we should have in tobacco. I am unfortunate enough not to know what the shade is. There is a roll of tobacco on the table there. If the doctor can show what the fashionable color is, I wish he would.

DR. JENKINS. I should call that [showing] a beautiful shade of tobacco. The trouble with our leaf is, it is too big to suit the cigar manufacturer. This cuts to too much waste. You get two, or possibly four, wrappers off, and then you have a lot of waste. In Sumatra he has the four wrappers out of it, and he is done. There isn't enough left to clutter the floor, hardly.

Mr. RUSSELL. We have attempted to raise small-leaf tobacco by setting it thicker, — setting the plants very much nearer together. We don't have much success in that way. It grows up higher, and throws out big leaves.

Dr. JENKINS. No. We set the broad-leaf fourteen inches apart and the rows three feet three, but it didn't diminish the size of the leaves much, — planted even at that distance they were as big as blankets.

Ex-Governor HOARD. How would it be to try a little poorer soil?

Dr. JENKINS. It will do it.

Mr. RUSSELL. What will be the quality?

Dr. JENKINS. I don't know. I think in Cuba, where they have pretty poor land and pretty poor owners, it is likely to have a better aroma than when the leaf owners plow in a lot of fertilizer and get a big crop. What we want is tobacco that has no flavor. The more it has, the worse it is off. But where they grow it out in Cuba, flavor is the great thing. I think the poorer soils, with insufficient manure, are quite as likely to give a rich flavor to the leaf as better soils.

Mr. C. F. FOWLER (of Westfield). I should like to ask one question. You said our tobacco was too large — a fifteen or sixteen inch leaf was of more value. I should like to know who you mean it is of more value to, — the grower, or the man who buys it? A buyer won't pay one cent more for the small tobacco than he will for the larger, if as much. What are you going to do about it? Are we going to raise that little stuff?

Dr. JENKINS. That objection is well taken. If you have a crop next year of sixteen or eighteen inch leaf, the average buyer that comes around will not give you a cent more for it than for the same quality of larger leaf. I do not believe at first you would get any more money for it unless you made a special arrangement with dealers before you raised the crop. They want to buy it as cheap as they can, and when they are buying they see all the faults and none of the virtues. But it is much more valuable to the manufacturer, and ought to be of much more value to the farmer to raise.

Mr. COOK (of Hadley). If we grew this small tobacco, wouldn't it obviate some of the trouble in the sweat? Would it be as liable to sweat?

Dr. JENKINS. I do not know how it would be in that respect.

Mr. COOK. On the pole, I had reference to.

Dr. JENKINS. Well, I think it would not be so apt to full up and stop the circulation of air, if the leaf was smaller.

Mr. PARSONS (of Northampton). I would like to ask the doctor how we can tell when tobacco is just ripe.

Dr. JENKINS. It is like making bread. You can't give rules. It is a matter of judgment, and has to be instinctive. A tobacco grower knows when a leaf is ripe, but he can't tell you how he knows. It is the old time method to pinch the leaf and see if it will crack. That doesn't work in Sumatra. I have seen Sumatra in the morning that was lush and full of water, that would crack beautifully when it wasn't ripe. When it is ripe there is apt to be a very slight yellowing on the tip or near the tip, on the edge of the leaf. The leaf is a little puckering or drawn, the surface not as smooth as before and shades off in color, and here and there on the surface of the leaf you can see little dark spots, dark-green places, not uniform green, but mottled, although on Sumatra we don't see it distinctly. On the domestic leaf the yellow mottles are more significant of the dead-ripe leaf.

Mr. COOK. I meant the domestic leaf, raised out of doors.

Dr. JENKINS. On that we think the cracking of the leaf is a sign more characteristic than in Sumatra. There we have these yellowish-green blotches on the lining of the leaf in places. That is a pretty sure sign of full ripeness.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock by First Vice-President Sessions, who said: Doubtless you are all aware that the business of dairying is a most important branch of agriculture in Massachusetts, as perhaps it is in most other States of the Union, and you who have had ex-

perience in the world know there are many things in which the best of us might do better. The secretary and committee have looked over the country for the man who could give us hints that would be of value, not only that would be of value, but that would be pointed and come home clearly to our understanding and in a way to interest us. They have found a gentleman who has spoken to the people of Massachusetts under the auspices of this Board before, but, considering all the circumstances, it was thought by the committee that no other man could fill the place better, and I now have the pleasure of introducing Ex-Governor W. D. Hoard of Wisconsin, who will address you on "Dairy Economics."

DAIRY ECONOMICS.

BY EX-GOV. W. D. HOARD, FORT ATKINSON, WIS.

The other day an old farmer friend of mine, hearing I was going to Massachusetts, asked me what I was going to talk about. I replied "Dairy Economics." He looked a little puzzled, and said, "What's that?" I knew him to be a close thinker and a most thorough manager of cows, and yet my topic was as Greek to him. And the more I have studied it, the more I find it is too big for me. Webster defines economics as the "science of utilities, or the useful application of wealth or material resources." So you see there is a very wide field here, and you need not wonder if I very inadequately fill it.

There has been a wonderful marshalling of thought, and both practical and scientific investigation on the question of dairy farming in the last thirty years. No other branch of agriculture has been so greatly enriched by the best thought of the age. This is partly due, I think, to the fact that the dairy farmers are so largely organized in creameries and cheese factories. Such organization has served greatly to place them within the light. If he chooses, the dairyman can face it, and learn what it has to disclose. He can also turn his back to it, as hundreds and thousands are doing.

This light has come very largely from scientific men like Dr. Babcock, in his discovery of the famous milk test and what the agent is that cures cheese; from the bacteriologists, in their investigations into the diseases of cattle and the causes of milk deterioration; from Henry, Roberts, Jordan, Armsby and others, in their investigation concerning the economy of food assimilation; from the students of scientific breeding, who are patiently exploring this great and mysterious field for a knowledge of the physiological principles

that must govern the outcome of all effort, whether intelligent or ignorant ; from such profound students as Professor King, who, in his late work, “ The Physics of Agriculture,” has thrown a flood of light on principles and effects which should govern in the construction of farm buildings and stables and the growth of farm plants, as well as thousands of other matters and things which pertain to an intelligent understanding of the work we have in hand to do. The scientist is unfolding the truth much faster than the farmer is assimilating and applying it. .

It is to be greatly regretted that so many farmers have a prejudice against learning anything from what they can read. They call it “ book farming.” This is the plea of ignorance, not intelligence. What would be our condition if the same prejudice prevailed in society against “ book ” law, “ book ” medicine, “ book ” engineering, “ book ” architecture, and so on?

What I have to offer to-day will be along the line of the relation of the utilities and their relation to success or failure.

The more I look into the actual contact of the farmer with the cow, the more I am astonished at the vast number of men who are living on the ragged edge of the business. But few, comparatively, are intelligent, successful dairymen, following intelligent methods, and justified in their course by the best endorsement in the world, — a good profit. There is a vast deal of profound ignorance abroad, and the policy of a great number of farmers in the conduct of their herds is governed more by what they don't know than what they do know. But a still more discouraging feature is their indifference to their better education. They have come to this business with too low ideals of what it really means to be a dairyman, what a dairy cow means, what the breeding of her means, or the meaning of her proper feeding and dairy environment. Their fathers got along in the crude old days with little knowledge, and did fairly well ; and they say : “ Why should I make any special effort to know any more than they did? Isn't the cow just the same as she was then ? ”

It is so easy to be unconscious of outer changes, especially if we live on a farm. Everything has changed in economic relation in the past thirty years. Market demands are different. With the increase of cow population has come a vast increase in disease and danger; fertility of the soil has decreased, and cost of feed, as well as family expenses, have increased; modes of tillage, storing of fodder, construction of stables, and a thousand and one details have been overhauled by modern thought and investigation. Many old ideas and methods have been rejected as being inadequate to the present order of things; new ones have been adopted; a flood of light has been poured on the question by human experience. Yet I can find thousands of farmers in every State who have the same idea of a cow they had thirty years ago, and who really know but little of these changes. Their cows are no better than they were then, and they are making milk more expensively to-day than then.

They are being pinched sorely; the old farm is growing ragged and unproductive; the boys are only too glad to get away.

Nowhere in or about the business is there a suspicion of the idea that this is a work of brain; that it calls for strong reading, familiarity with the best thought of others, deep intellectual thinking, intelligent study and wise adaptation of means to ends. The young men cannot help but avoid it, for to them it has never been anything but drudgery and unrequited toil. Too few farmers believe that their sons should have the advantage of special training in the short course at the agricultural college or at the dairy school. Too little outlay is made to bring into the home dairy literature. The standard books of the day on dairy questions, such as Gurler's "American dairying," Henry's "Feeds and feeding," White's "Thirty years among cows," and many other most excellent modern works, are indispensable, if a farmer expects to have a well-informed mind concerning this business. I have known many young men to take new and absorbing interest when such works were brought within their reach, and they were given a chance to see the scope and meaning of dairying.

On this question of farm education permit me to say that the State of Wisconsin has taken an advanced position. By act of the Legislature, six training schools for teachers of country schools and two county agricultural schools were provided in the past year. This is to the end that eventually the elements of agriculture may be taught in all the country schools. We hope thus to instill into the mind of the farm boy a love for the study of agriculture, and consequently secure his retention on the farm. A small plat of land will be attached to each school-house, and every boy will be given a rod or so of ground, in which to study how plants grow. Thus farm botany will be taught practically, and to some purpose. The boy, the farmer that is to be, will learn more in a month of the laws which govern plant growth than he usually does by years of ordinary usage on the farm.

In the county agricultural school we hope to bring the agricultural college close to the farmer in a way he can see and understand. In the county training school the teacher of the country district school is to be trained how to teach ideas and judgments of things that belong to the future welfare of the farm boy, as such. There is a great wealth of knowledge here that needs to be imparted, if the farmer of the future is to be any improvement over the present, and the State be served with a broader and more useful agricultural citizenship.

There is the highest conception of economics in such an idea of farm education, and I am glad that I have lived to see the practical thought of the age commence, at least, to grapple with it.

A study of this question leads us out in a great variety of ways. What shall be done to educate the producer to increase the quality and healthfulness of dairy food, so that the public shall have increased confidence in its use. What shall be done to educate the consuming public into an understanding of the value of milk, butter and cheese, — not as a luxury, but as a most desirable and economical food? What shall be done by the farmers, as a great political force to turn the power of public sentiment and law into

active opposition to all forms of adulteration and counterfeiting of dairy food?

And right here let me say that these forces must be invoked in behalf of the consumer, mainly. He is the one most preyed upon by fraud. In his injury is the producer of honest food most seriously hurt. How potent this is to teach us "that no man liveth to himself alone."

Lastly, to so broaden the mind of the dairy farmer that he shall see that true economy consists in a wise expenditure of means; that, as Isaiah saith, "The liberal deviseth liberal things and by liberal things shall he stand." To be stingy of mental effort or money in the prosecution of dairying is not economy, that is parsimony.

There is only one place where, I think, it is every farmer's duty to be stingy and that is toward waste. The logic of this question calls loudly for a deeper study of the question of fertility and the conservation of manures. Solid manure exposed for one hundred and four days has been found to lose 37.6 pounds of nitrogen for every 100 pounds contained in it; 51.9 pounds of phosphoric acid from every 100 pounds; and 47.1 of potash. Solid and liquid combined loses 51 pounds of nitrogen, 51.1 of phosphoric acid and 61.1 of potash for the same length of exposure. More than half of the real value of manure will be lost by exposure of four months. The amount thus lost from one well-fed cow would cost \$12.50 if purchased in the form of commercial fertilizer.

In my own experience I have found the highest economy in a liberal use of land plaster in the stables and manure pile. Add to this the hauling of the manure every day where the lay of the land will permit it. I find that the labor cost of the hauling is much less in winter than in the spring or fall; that I have saved great loss from leaching and evaporation; that it is much more cleanly and healthful for the cattle and the condition of the yards. I count that the land plaster returns to me fully double what it costs. The effect of the plastered manure over the unplastered can be readily seen where both are used in a field of corn side by side.

CLEANLINESS, ORDER, NEATNESS.

A great many farmers do not possess a civilized idea of cleanliness in the management of cows; they seem to be slovens by instinct. Every creamery in the land has to contend with them, and the bad effects of their management. It seems to be impossible to make them realize that there is a money value in the health and efficiency of their cattle, as well as increased price for their product, if they will but practise cleanly methods. Take this observation with you, and note if I am not right: The neat, clean, tasty farmer is almost invariably a successful one; he never wastes. Uncleanliness means disorder, and disorder means waste, and waste means loss.

I have two dairy farmers in mind as I speak. The first was a neighbor. He farmed for twenty years on the same farm with a fine herd of Jersey cattle, most of them registered. He died leaving his farm covered with a mortgage of \$3,000. He was never an orderly, neat farmer. His widow, a very capable woman, took up the task, and in ten years had paid up the mortgage, managed the help and the cows, cleaned up the fields and made tidy every fence corner, educated the children, and now has a handsome deposit in the bank. Woman-like, she did not tire at small details: she was close and orderly in her ideas of farm and cattle management; she allowed nothing to go to waste; she employed always sufficient help to do her work well; she had no expensive habits. The farm is increasing in productiveness, and she is a pronounced success.

In the interest of dairy economics, I believe I would like to see the wives of many farmers handle the farm and the cows.

FALSE PRIDE.

Here is another uneconomic factor which aids greatly to keep the dairyman in a fog of self-conceit, and serves to confirm his ignorance. Mr. F. L. Marion of North Woburn, Mass., in a communication to "Hoard's Dairyman," last February, says:—

I've visited several large dairies that claimed to be doing advanced dairy work and putting up especially clean milk. The

first time all received me kindly and showed me everything, and wanted a report of what I found. Before I took samples, I told them, all but one, that I thought they would be disappointed in the report, and pointed out several things that were spoiling every thing else they are doing. They didn't agree with me, so I said: "I'll take samples, so and so, and if there is an increase of bacteria at this or that point, it will prove my point, won't it?" And they all said yes. Every case came out as I expected. In all cases, with their modern barns and clean cows, etc., the bacterial content was from 50,000 to 500,000 bacteria per cubic centimeter, and that of milk sampled at 4 p.m. and plated at 6 p.m. or sooner of same day, and counted in thirty-six hours. When I reported, all save one were wroth. I didn't try to find out whether with me or themselves. *One, though surprised and disappointed, has set about to remedy the defects.*

WINTER DAIRYING.

Experience has shown to the experienced that there is a great advantage in having the cows come fresh in the fall, rather than the spring. These advantages are:—

1. Larger production, in consequence of more and better feed, exemption from flies for eight months, and less exhaustive exercise in ranging over barren pastures.
2. Increased price for the product.
3. Greatly increased quality in the calves.
4. Better conservation of the manure.

A comparative experiment was carried on for two years by Superintendent Robertson of the Maritime Experimental Farm of Canada, with eight cows, divided into two groups of four each, and of as equal dairy potentiality as possible. This experiment demonstrated that the fall-calving group gave a direct cash profit of \$10.65 per cow more for the year than did the spring-calving group.

This experiment coincides fully with my own judgment. Many farmers find it somewhat difficult, however, to effect such a change with their cows. They will find it comparatively easy to start the heifers in that way. Breed them in December or January, and even as late as February, and they will thereafter all the more readily bring their calves in the fall. In this way, in a few years the herd will be made up almost entirely of winter dairying cows.

RAISING MORE CALVES, PIGS AND POULTRY.

The raising of young animals is one of the most natural adjuncts of dairy farming. In my observation there has been a decided falling off in this respect in the Atlantic States during the last twenty-five years. The cows have increased, but the raising of young cows, and the pork crop, have decreased. This constitutes one of the distinctive differences between butter dairying in Wisconsin and dairying for milk in the east. More than twice the number of young heifers are matured to cowhood, and four times as many pigs are raised in proportion to the number of cows kept, in my opinion, as is the case in Massachusetts.

The feeding value of skim milk with us varies from twenty-seven cents per 100 pounds when fed to young pigs, at present prices of pork, live weight, to 35 cents when fed to likely young grade Jersey, Guernsey or Holstein heifer calves. This makes a handsome addition to the revenue per cow. Many of the eastern farmers seem to have almost lost the art of raising young stock. It is time it was taken up again, and in creamery districts, and where private butter making is carried on, it is just as practicable to do this east as west.

With plenty of fresh skim milk, separated on the farm by the aid of the farm separator, and middlings, barley or corn meal, it is comparatively easy to make a good profit on raising young calves to two-year-old cows, and young pigs to 150-pound porkers, and poultry galore. The fresh skim milk unlocks all these possibilities. The highest profit is found in turning all these to the market when young. The pigs especially should not exceed 150 pounds weight, for after that the food of daily support decreases the ratio of profit very rapidly. Then there remains the importing of increased fertility to the farm. The old cheese-making districts of New York show what it means to send all the milk away from the farm. The farms there do not raise half the cow food they once did.

SPECIFIC BREEDING FOR DAIRY PURPOSES.

One of the most uneconomic conditions that prevails to-day is the loose, impractical notions that exist among farmers on the question of breeding. The farmers will concur with you that if you would win at trotting, you must breed for trotting; if you would hunt fowls, you must have a dog bred to that purpose; if you would harvest grain to the highest economy, you must have a self-binding reaper; if you would weave cotton cloth, your machine must be constructed for that purpose; if you would sew, it must be with a sewing machine. On all these things and hundreds more he is clear and logical in his judgment. But with a great host of farmers the moment you show them a cow they are lost in a fog of the wildest conjecture. They will buy a Jersey sire for richness of milk; then in a year or so a Holstein for quantity; then a Guernsey for color of butter; finally, they will cap all climaxes by buying a Short-horn for more size and more meat. So, as you travel over the country and look at the herds of cattle, like those of Jacob, "ring-streaked and speckled," you can see what this hodge-podge, general-purpose and no-purpose-in-particular idea has done for our cattle.

One fact I wish to state at this point: the cow that comes from a long single line of dairy-bred ancestors will take her food and work it up into milk solids much more economically than the dual-purpose or beef cow. This was shown very clearly at the World's Fair trial in Chicago, and at the model dairy test at the Pan-American. Jay I. See, the famous Wisconsin trotting horse, trotted his mile in 2.10 on 12 quarts of oats. Here was shown marvellous economy of food expenditure for the results given. The Poland China or any of the breeds of swine bred to a fattening purpose are so economic of digestion and assimilation that they will make double the weight on the same cost of feed that the Arkansas razor back will.

But let me cite facts. "Hoard's Dairyman," in 1900, took a census of 100 herds of cows owned by patrons of creameries in Iowa. That State is the paradise of the

general-purpose cow. The total number of cows in these 100 herds was 982. There were 4 herds that ranged from \$2.11 to \$2.30 for every dollar's worth of feed expended. There were 61 besides out of the 100 which averaged from \$1 upwards for every dollar's worth of feed consumed, the highest of these being \$1.91, the lowest \$1. Of these, 12 returned from \$1.50 to \$1.91; 23 herds returned from \$1.20 to \$1.50; 26 herds returned from \$1 to \$1.20 for each dollar expended in feed. Now we come to the dark side of the picture: 35 of these patrons out of the 100 received less than \$1 from the creamery for every dollar they spent in feed, and this loss ran all the way from 2 cents on the dollar to 66 cents. Understand, now, that every one of these men was taking his money, the best as well as the poorest, from the creamery: 65 received over \$1 for each dollar's worth of feed; 35 received less than \$1. The extreme contrasts are one man receiving \$2.30, another 44 cents. Now, was it the creamery or the patron that was responsible for this difference?

Mr. Kinsley classified the 100 herds as follows: "dual purpose," "high-grade Short-horn," "natives," "grade dairy," "high-grade dairy," "grade Jerseys." The four herds that gave from \$2.11 to \$2.30 for every dollar's worth of feed were "high-grade dairy" and one "high-grade Jersey." Every one of the 35 herds that reported a loss for every dollar's worth of feed consumed were "dual purpose," "grade Short-horns" and "natives."

This is a free country; a man has a right, if he chooses, to keep steers to do the work of horses: to go on the trotting track with draft-bred horses; to use the general-purpose reaper for cutting grain and corn, if he can find one; but in none of these places will he find that the hard, unyielding laws of economics will get out of his way for a moment. They will never make any allowance for his likes or dislikes, his prejudice or his ignorance. They govern in the great world of physics everywhere. A thing must be made for its purpose, whether it is an animal or a machine, if the best profit at the least cost is to be obtained from it.

VENTILATION OF STABLES.

I spoke on this question several years ago, before your Board, at the meeting in Dalton. Since then, thanks to Professor King, splendid progress has been made in this direction.

I desire to urge upon the New England farmers that they give to this question their most earnest consideration. The spread of germ diseases among cows, fostered and nursed as they are by the close, foul stables, has caused serious alarm. The dairyman recognizes that if the cow yields milk in winter she must be kept warm. He must depend for heat on the bodily warmth of the cattle. If he ventilates by any of the old methods, he will lose this valuable heat: hence he doesn't ventilate. He packs his cows closely in a tight stable, and refuses to study the question. Maybe he is afraid he will find himself wrong.

The new King method conserves the warmth, constantly introduces fresh air and draws off the foul air. Two years ago I built a new barn with this system attached. Several of my neighbors asked me what it cost extra. I replied, "\$350." Then they would say, "Do you think it pays?" My answer was as follows: "You admit that you never saw a better smelling stable; the cows show by their bright, vigorous appearance that they are in a healthy atmosphere. Their work at the pail tells that also. The interest at 6 per cent on the outlay is \$21 annually. Money is worth only what it will win in interest. I have loaned \$350 to my herd of 40 cows; that is about 50 cents per cow. Would you, if you were I, change these cows to the usual cow stable for 50 cents per cow a year?" They always admit they would not, yet very few adopt the improvement. I am greatly pleased with it, and my cows seem to enjoy it more than I do.

There are many other phases of the dairy question which I would like to dwell upon. It is, as I said at the outset, a wide field.

In conclusion, I wish to quote a paragraph from Prof. F. G. Short, because it is so clearly pertinent to the question,

and the situation that most of the farmers of the land are in : “The highways and byways of the kingdom of cowdom are dark indeed ; and, were it not for the few lights that are hung on its outskirts for the guidance of the pilgrim, in the form of milk analysis, feeding experiments and digestion trials, we would have a much more foggy path than we now follow, especially as those two fellow travellers, Wisdom and Cash, must follow each other closely, *if they arrive.*”

MR. WILLIAM ATKINS (of North Amherst). I should like to know about the King method of ventilation, — how it is arranged.

EX-GOVERNOR HOARD. Two years ago I published the whole system, illustrated by diagrams. May be I can show you by illustration.

We will suppose this room to be a stable. My barn is constructed on one side with a heavy earth wall, — that is, against the bank. I don't use stone for a wall to a stable any more than I can help. I can construct more cheaply with wood, although I have stone on the farm, and then I can construct as I want to. I wish to make a warm barn, so that the stable part is constructed in this wise. First, 2 by 4 studding : on that is clapboarding ; then on the side I run building paper. That makes one air chamber. Then 2 by 2 is spiked against that studding, and another partition of building paper, and then another 2 by 2 against that, and another partition of building paper, and then up and down on the inside with half-inch lath tacked on, and a ceiling all over the inside of the stable overhead and all around. That makes three or four divisions of air chambers, — just the best kind of insulation against cold. We have it 20° below zero sometimes, and frost will extend right through a wall. You always notice that cattle that stand next to a wall don't thrive as well. Then there is a window every two feet clear around, — as often as I can stick one in there is a window ; for I know that cows have the same curiosity that boys do, they want to look out and see what is going on, and I make every provision possible for the cows to look out doors and see what is happening.

Then, the system of ventilation is this. The barn is in the form of an L, 142 feet long. At the intersection of the L stands a shaft, 3 feet square, that rises clear above the ridge line, with galvanized iron so as to make it air tight. Now, that is depended on to draw off the foul air, and in this, even with the floor of the stable, on this side of the shaft [showing] is a 21 inch register, and on this side [showing] the same way, leading into the shaft, so that here is a current of foul air thrown off by the cows' breathing, being about 15 per cent heavier than common air. The stable floor is composed of plank. I don't use cement. This mammary gland is a peculiar and wonderful gland, and I don't want any danger to it from that source. I have never had a case of garget in my herd, and I think it is due to the fact that I guard against it specially by conditions.

Now, then, that is the process by which the foul air is drawn out. How shall the pure air come in, and not lose the heat? We shall call that [showing] the wall of the stable, and this down here [showing] the outside. Down here [showing] is a 12 by 12 iron register, open all the time. Now, the air rises up between the studding, this outside partition, you know, this outside space of 4 inches there between the studding, it rises up and the paper is broken through the top even with the ceiling, and it comes in here [showing] in another 12 inch register that you can shut or open, as you are a mind to. Those are running clear around the stable, even with the ceiling. Now, the pure air rises up and comes through this strata of warm air. The warm air is always up against the ceiling. All the hay chutes and silo chutes are kept shut, so there is no drawing off of the air in the barn above, and this warm air rises up and comes through, and, being lighter, cannot flow out through that same register. The warm air comes up in here [showing] and then down, and the cold air rises and goes through, and the warm air is retained. So all around this barn, with about 50 or 60 animals, young and old, are these different registers, and the air pouring into the barn and pouring out at this central shaft. That works all the time automatically, and the air in that barn is clear and

clean, even shut up as it is at night. If you go into it in the morning you will have a pretty good sense of smell if you can detect the odor of a stable. The air changes automatically about every hour, and it is held steadily at about 55°. Now, that is the system of ventilation. Care must be taken always that this air is let in down by the wall on the outside, rises up and goes through, and comes in at the ceiling, and the barn must be sweet. You must expend enough to make the barn right, and then you can control the currents of air, and have them go where you want them to.

Dr. J. B. LINDSEY (of Amherst). I simply want to shout amen to what the speaker has said. I could not get over here from Amherst last night, because of the storm, so I sat down and picked up a copy of "Hoard's Dairyman," and I read over the address which Mr. Hoard gave before the Dairymen's Association in Iowa, wherein he gave the result of his cow census, as he calls it, 100 herds examined, 35 per cent of 100 herds kept at a loss; and I said, "How is it in Massachusetts? Are we any better off?" Sometimes when I get into a carriage and ride around about Amherst, or in other sections of the State, I look over the herds and fear for the result.

Just one point, gentlemen, this summer my friend Professor Cooley wrote an article in the Massachusetts "Crop Report," where he gave his ideas relative to the dairy herd, and when I had finished reading it I said: "I wish every farmer interested in that matter could read that little article, because it contains so much that he ought to know." Yes, that you and I as dairymen ought to know; it contains so much good sense compressed into such a small mass.

Mr. H. C. WEST (of Hadley). Is a fat cow better to milk than a lean one, or does feed have any effect upon the product of the cow?

Ex-Governor HOARD. The question is, does a fat cow give better milk than a lean cow? Sometimes yes, and sometimes no. It all depends on the cow.

Mr. WEST. I mean the same cow.

Ex-Governor HOARD. Would she give better milk when fat?

Mr. WEST. Yes, sir.

Ex-Governor HOARD. No; a cow doesn't give better milk when in flesh than when she is lean. Show me a woman with a fat baby, and I will show you a lean mother. I had a wife that taught me more on this thing than all the other sources in the world. She was the mother I could question concerning this other mother I could not question. So you may see some reason for my belief that a woman knows more about dairy matters than most any man. She knows more about the cow. She is a mother. No, a cow doesn't give any better milk when she is fat than when she is lean. The other question is, does feed have any effect on the milk? Yes, it has some effect on the milk. It is the source from which the milk is obtained; but the man that thinks he can feed fat into a poor cow, or a cow that gives poor milk, will find himself most tremendously mistaken. A good cow first, and the supporting effect of the feed afterwards.

QUESTION. Isn't it better for a cow to come fresh in good condition than to come fresh when she is poor?

Ex-Governor HOARD. Well, I don't want the cow to be emaciated or poor, I want her to be in good, strong health when she comes fresh; but I don't worry about her a moment, that she should grow lean while she is being milked. I would rather see her do that than grow fat.

Mr. WEST. Whether feed has an effect upon the milk? Whether you can make better milk from the cow by certain kinds of feed?

Ex-Governor HOARD. By a wise choice of food you can support the milking function in the cow, but the working up of the solids is in the cow herself.

Mr. JOHN S. ANDERSON (of Shelburne). I wish to ask you if, as a rule, a cow does not do better when she comes in in fine condition than when she comes in poor? Further, where does that flesh go to? Doesn't it go off in the pail, and won't the cow give more pounds of milk, make more butter, when she comes in in high condition than when she comes in thin?

Ex-Governor HOARD. You have certain dangers if she comes in in too high condition.

Mr. ANDERSON. That does not answer my question.

Ex-Governor HOARD. As near as I can answer it, you are in greater danger of various disturbances to the milking function. You are in danger of milk fever, if your cow is in high condition. I don't want to see my cow in high condition. I don't aim to have flesh, but to have her thrifty and all right. You ask me where the fat goes to. I don't know. Do you?

Mr. ANDERSON. I suppose it works off in the milk. Experience of fifty years teaches me that may be the case.

Ex-Governor HOARD. I don't know where it goes. I reason inferentially, as you do, that the flesh of the body is in some way changed over, but I do know that butter fat is not animal fat. Butter fat is not pure fat. Butter fat is altogether different fat, both chemically and physiologically. That is a most mysterious proposition. How can one be changed over to the other?

Mr. ANDERSON. Well, I want to ask you if you suppose it is possible to have the beef and the milk points in one animal profitably?

Ex-Governor HOARD. Not to the best profit.

Mr. ANDERSON. I want to relate a little something that happened a few years ago. At the suggestion of a gentleman from Middlefield, I went over there and purchased a Short-horn animal that came from Samuel Thorn of Schenectady, N. Y. We bred cows from the animal, and we had 10 cows that through one winter, for four months, gave 80 pounds of butter a week. Those cows we fattened for the market, and they dressed at 1,200 pounds apiece. Those cows went to market and brought us \$320. One cow we raised from that animal one of my neighbors had, and from that cow, in one season, besides using the milk and cream in a family of five, he made a little over 500 pounds of butter. Now, gentlemen, there was a dual-purpose cow.

There was a cow that produced not only beef, but milk; and I think we can have and have had, and have to-day and shall have in the future, a dual-purpose cow in the Short-horn. We have to-day in our barn cows that will make 1,200 pounds of beef, and that are giving 20 to 24 quarts of milk a day, and the calves sell without any

trouble for from \$100 to \$150 when ten months old. Now, gentlemen, there is a dual-purpose cow. Time was in old Shelburne when we could show 40 pairs of cattle that averaged 3,800 to the pair, and at that time every man had the Short-horn cow. He could go out anywhere that he listed and pick out a cow that would make 14 pounds of butter, and from that up to 20. I could do it, and I could purchase steers. We had two pair that brought us \$1,400 for beef. The times are different to-day. There are not so many of those nice cattle as there used to be. The Short-horn has been replaced by the Jersey, the Guernsey and the Holstein, and they have never filled their place, and they never can fill their place as a dual-purpose cow; and the Short-horn is the dual-purpose cow, and I shall always maintain it.

MR. J. W. GURNEY. I conclude that the gentleman from Shelburne asked his first question with the idea which was in my mind, and that was, whether or not butter or butter fat could be produced cheaper in the fleshy cow or the lean one; and I would like to ask that question. We may go out to buy a fat, good-looking, fleshy cow somewhere, and we find a good-looking, lean cow. Now, is it more profitable for us to buy the fleshy cow, — can we feed her and get better pay for the feed?

EX-GOVERNOR HOARD. I refer you to an experiment in the Minnesota station by Professor Haggard, with two cows, Dido, a beef-temperament cow, and Houston, a dairy-temperament cow. Now, physiologically, these two functions, the production of milk and the production of flesh, are based very largely upon the question of temperament. For instance, to show what I mean, you take the race horse, and he has the speed temperament; you take the draft horse, and he has the draft temperament; and you can't get a commingling of the production of speed and draft from either one of them. Now, this cow Dido gave 200 pounds of butter in one year, and that is more than the average, and her butter cost 16 cents a pound, if I remember correctly, to produce it. The cow Houston gave over 400 pounds of butter in a year, and her butter cost 4½

cents a pound to produce it. Take two pigs and put them in the barn, weigh them and weigh the food given to them, and one pig produces a growth of a pound to a pound and a half a day at a certain cost for food, and the other pig doesn't produce more than two-thirds of that growth at the same cost in food; and you see, don't you, that the economic proposition there is in favor of the first pig. Take the recent experiments at the Pan-American Exposition. You find they were based upon the question of the expense, the cost; and you find that certain animals there produce, not a poor result, but at an enhanced cost. Now, it has not come within the comprehension of the average farmer in this country, until within a few years, that this great factor of economic cost and the food proposition is a constant one. We cannot get away from it. Now, my friend here speaks of the Short-horn cows. I have known some magnificent Short-horns. One of my neighbors had a Short-horn cow that gave him 18 pounds of butter a week, but that doesn't tell the whole story. You would expect that this cow would breed a magnificent herd, but that cow gave him three heifer calves, practically worthless. That cow possessed the beef temperament. As a milker, she was a sport. She couldn't breed the heredity which lies in a long line of stored-up heredity in that direction. I know a half-breed trotting horse, bred from Clyde, and this mare shows phenomenal speed, and she trotted as well as 2.22 or 2.23; and the man who owned her has bred from her three colts, and not one can trot a mile in 4 minutes. Now, why? These laws of breeding,—I wish I could get men to patiently think on this question. It is not a question of partisanship with me, not a question of whether I love the Guernsey cow, or the Jersey, or the Holstein. It is a question of physiological study. Is there any reason in the law of dairy breeding? Yes, says everybody. Is there any reason in the law of beef breeding? Yes, says everybody; and yet, the moment he is left, that man proceeds to juggle with it. We could find some in every herd of cattle bred in New England fifty years ago showing splendid dairy qualities; but I think my friend will have difficulty if he

attempts to go to-day and select from the beefy Short-horn cows a one-purpose cow, of dairy quality of stock.

Mr. ANDERSON. I have done it for fifty years.

Ex-Governor HOARD. We haven't had them for fifty years, that class of Short-horns, — the heavy, beefy animal.

Mr. ANDERSON. We don't want them. That is the worst kind.

Ex-Governor HOARD. Now, we are getting to the germ of this question. I am speaking of the dairy temperament, and it may be Short-horn, but it must be preserved. Yet we import from Illinois and Kentucky the beef-bred Short-horn, and destroy the dairy quality.

Mr. ANDERSON. I don't doubt that; but I wouldn't do it, sir.

Mr. WESLEY B. BARTON (of Dalton). I wish Governor Hoard would give his experience in growing cheap protein.

Ex-Governor HOARD. Well, that is a wide question. Mr. Barton asks me to say something about growing cheap food. I discovered that alfalfa was the most valuable dairy food that could be produced, and if I could produce it, I would have something right to my hand. I have been at work on this five years. In Wisconsin it was the universally accepted idea that alfalfa could not be grown. They experimented with it. Professor Henry did not think it practical, but I knew it could be, and I kept attempting it. I devoted four acres of ground belonging to my home to the experiment of setting alfalfa, and I have been setting it bountifully and cheaply, and I have had a whole lot of mixtures with it, and I have found every one of them to be of good service to me, until to-day I have twenty-eight acres of alfalfa on my farm. I will say to you that this last summer, with the most destructive drought ever known in the west, I cut three splendid crops of alfalfa hay, and have a barn full of fine alfalfa hay, and it has been the amazement of all my neighbors. Now, a word as to what it is worth. I went down to Professor Voorhees in New Jersey last winter. He has been experimenting with alfalfa for two years, with a herd of 40 cows, and he shows clearly that 11 pounds of alfalfa hay, cut at the right time and cured rightly,

is equal to 8 pounds of mixed grain, as a milk producer, — 8 pounds of mixed grain, usually corn, oats and bran. He could produce 4 to 6 tons per acre.

I will now give you a few points. In the first place, you need good seed. In the second place, you need to sow double what any man has ever told you you ought to sow, — not less than 25 to 30 pounds to the acre. In the third place, the land should be put in the proper, the very best condition. It should be plowed at least twice. The better the soil, the better the alfalfa. It should be land that will readily and easily drain, land that is deep, that the alfalfa can make a growth in, for in three years you will find the roots twelve or fifteen feet down. You must have a deep soil, it must not be underlaid with rock within two or three feet, or you will have only a short season of alfalfa. Remember, alfalfa is perennial, — it lives forever. I can show you plots planted in Colorado one hundred years ago. It must not be within ten, or fifteen or eighteen feet of the water line, — that is, water-bearing strata. It likes moisture and goes deep for it, but it must not have wet feet, and it should be dressed every time with at least from 30 to 50 bushels of lime to the acre.

THE CHAIR. Every year?

EX-GOVERNOR HOARD. No, when you prepare the soil. It is well to give it a light dressing of lime every year. It is also a great lover of potash, and I buy all the ashes I can find in two towns, and pay 10 cents a bushel for them and do the hauling, and I get all the ashes, and everybody laughs to see poor Hoard drawing ashes. You know you can afford to let some folks laugh. Then, another thing. When you sow it you must either sow it alone entirely or with a nurse crop; and if you sow it with a nurse crop, sow it with oats or barley, and cut it just as quick as it heads out. Don't wait for them, because it takes 500 pounds of water to mature 1 pound of grain. That was demonstrated by the Wisconsin Experiment Station and others. You take an average yield of 50 bushels of oats to the acre, and you are taking 80,000 pounds of water out of the soil; and add to that all the water being drawn out by the sun, and no

wonder the alfalfa suffers when you allow the nurse crop to ripen the grain. You try it next year. Select some excellent piece of ground, and try an acre. Don't try too much till you know the creature, — learn her ways. I saw at Professor Voorhees's where he had a three-year-old field of alfalfa from which he got 26,000 pounds of forage by waiting through the summer. He said he cut it four times. When you cut your alfalfa, you can then let it grow, and in the fall have a growth of at least a foot or more. Don't pasture it in any instance, unless it be with sheep or some light animals, for heavy animals tread down and kill it. I have noticed when I have drawn my heavy wagon over the field, it seemed to injure it, seemed to crush it. It is a forage plant. When it comes spring, and you come to harvest it, as the crop will be ready the last of May, when it is in the showery portion of the year, you will be obliged to use care in curing the hay. Get some sheeting forty inches wide and tear off a piece forty inches long, which will make a piece forty inches square. Make these into hay caps by some arrangement which will enable you to weight the corners. Go into the field, cut the alfalfa and give it half a day to sun. Then cock it up into about 50 or 75 pound cocks, and draw these caps onto them. I had a field of alfalfa, with about 500 cocks, go through three heavy rainstorms, and you couldn't have told it afterwards by the appearance. Now, then, you have to go with your fork and move those about every two or three days, or the heat will kill the alfalfa, and when it comes a bright, sunshiny day, throw off the cap and pick it all over and shake it up a little, if you think it needs a little more curing, but be sure and cock it up again, and let it stand from eight to ten days, cure in the cock, go through the first sweating. Then take it into the barn when it is quite moist, when it is tough, in order that you may save the leaf, because the leaves constitute the richest portion of it. Cut it when the first little blue blossoms begin to show, don't wait until it is all blossomed; for then you will see a natural coming up of the second growth, and you cut that in the same way. It is persistent, and bound to make seed. It is anxious to repro-

duce itself, and you keep cutting it just as it has commenced to blossom, when it is in the highest protein condition. Put it in the barn. It may heat in the mow some. Pay no attention. It will come out as green as the greenest hay you ever saw, more so, I think. I want to say to you right here that I am making my milk, which is one of the highest-priced of foods, nearly 50 per cent cheaper than I ever made it before. I give my cows about 35 pounds of ensilage. Last fall I gave them ordinary hay from 10 to 15 pounds, 8 pounds of grain, corn meal, gluten and bran. This year I am getting the same amount of milk on 35 pounds of ensilage, 10 pounds of alfalfa hay and 4 pounds of some kind of grain. If I can reduce the cost of making milk in this way, and do it by growing this material on my own farm, I am getting by this a tremendous advantage.

Professor Brooks. I want to emphasize everything ex-Governor Hoard has said in favor of alfalfa. At the same time, one or two points in our experience may be of service to men who undertake to manage it. One of these is my own experience, and I think it has been true also in the experiments of many of us about here. Alfalfa is very subject to a kind of leaf spot or rust, somewhat similar, as far as one can judge, to the ordinary rust. You see yellow spots on the leaf first; this soon spreads, and the leaves fall and the plant is soon dead. This disease is very troublesome in New York, as I learn through a most enthusiastic friend of alfalfa, and from him I received a hint that I want to make public here. When you notice this little leaf spot, cut the alfalfa at once. If it is the first year, there won't be enough to be worth harvesting, and this leaf spot usually will appear the first year. It does on our college farm. We cut it down and just leave it there. After the crop is better established, and there is enough to be worth haying, of course there would be no objection to taking it off. But unless this is done, unless you cut it as soon as this spot appears, you will find the plants will be very greatly weakened. We have been experimenting with alfalfa for a good many years now, but without any marked success so far; but I think it may be due to the fact that we haven't the

right kind of soil on our farm. We haven't any soil where we can go down 12 or 15 feet without finding water. Probably on the most of our farm we should find water at almost any month of the year certainly within 6 feet of the surface, and in many places within less than that. Now, it is of no use to try to grow alfalfa where it hasn't a chance to get its roots way down deep. If you gentlemen have that kind of soil where, if you should dig a hole and let it remain open through the growing season, the water wouldn't come in and stand, within less than about 10 or 12 feet, try alfalfa there, especially if the soil is of open texture all the way down. Otherwise, I would not try any more than an acre, any way.

Mr. E. H. FORBUSH (of Wareham). I would like to ask Governor Hoard two questions. The first is, can a man raise alfalfa on light, sandy soil with a gravelly sub-soil, and water 12 or 15 feet down? Secondly, do I understand Governor Hoard advocates the hauling out of manures in the winter and spreading them on the soil?

Ex-Governor HOARD. In answer to the first question, I am not prepared to say, yet. My soil is sand, and an ash clay as a sub-soil, and very deep. Alfalfa grows nicely there. I have another piece of land, that is bottom land, lying next to the Rock River. That has a very black, alluvial soil, and underlying it is blue clay, but not so very tenacious, and alfalfa does finely there. Anywhere it can get down. Now, in this question of soil, the sandy soil with a gravelly sub-soil, it would seem to be deep?

Mr. FORBUSH. I think so.

Ex-Governor HOARD. If you can make it rich. Alfalfa needs plenty of nutriment, particularly the first year of its life. If I can get it through the first summer, it is usually all right. Whenever I have sowed alfalfa on the land, I have given it a top dressing, and plenty of it, 300 or 400 pounds to the acre, and I give it a dressing of lime, nurse it that way, and a top-dressing of manure.

In regard to drawing out manure in the winter, we have to have a certain number of men working on the farm, and I never can use those men for this work so cheaply, at so

little expense, as to have them do this work every day. — see that the stable is thoroughly cleaned, and the manure drawn every day upon the land that I expect to plow for corn, as a rule. I usually grow 40 to 60 acres of corn, and all this land has to be manured thoroughly every year. Perhaps if I had hilly land, where there was danger of wash, I should not manure it in the winter, but manure it in the spring. Of course you want to apply gumption to all these things.

Prof. GEORGE T. POWELL (of Briarcliff Manor, N. Y.). At certain farms where 1,100 cows are being kept, for several years the practice has been not to have heifers come in until three years of age, instead of two. I want Governor Hoard to give the dairymen here present his opinion of that. We find, in studying up the records of these heifers coming in with the first calf at three years, that a very large number are giving from 6,000 to 7,000 pounds of milk for their first year, and producing from 300 to 350 pounds of butter. They are all Jersey cows. And in comparison with those that came in at two, the three-year-old records ran much higher. I should be glad to have Governor Hoard's opinion.

EX-GOVERNOR HOARD. Do you find that where the heifers are carried over to three years of age they are bred at twenty-six and twenty-seven months?

Professor POWELL. Yes.

EX-GOVERNOR HOARD. Do you find there is any increase in the number of them that are barren?

Professor POWELL. That has not been found to be so.

EX-GOVERNOR HOARD. Do you find they become rather beefy in appearance?

Professor POWELL. No.

EX-GOVERNOR HOARD. I have a dread all the time of a heifer coming to flesh. I don't want them to get into a beefy condition. I have often thought, at least, that I saw a starting of their growth in a heavy way, so for that reason I have always bred at fifteen months and had my heifers come fresh at two years of age, and I have thought that a good rule.

Professor POWELL. I would like to add one other point.

With all these great number that have been bred at three years of age, there is not a single instance of tuberculosis.

Ex-Governor HOARD. The reason is, you have kept it out. You don't think the breeding has anything to do with it?

Professor POWELL. Only from the stand-point that there is the tendency, and if you breed with too much immaturity, you may weaken the animal and render it more susceptible.

Ex-Governor HOARD. I have in my barn 20 young Guernsey heifers, a couple of years old this month and the next month. Those 20 are an object lesson to me. They are, I should say, 100 to 150 pounds heavier than the usual heifer at their age. They were reared with exceedingly good care. Every day they were fed warm skim milk fresh from the cow, for I use a separator in the barn and make the bull furnish the power. I strive to get the best start I can in the young cattle. I use about \$1 worth of ground flax-seed meal in the year and about \$1.50 to \$2 worth of oats to each calf, and I never have seen that system beaten. They had warm skim milk twice a day, and all they needed, and they had the oatmeal, and when they went out to pasture last summer they were given their skim milk, as much as I could give them, and then every two or three times a week a man went into the lot and turned into the trough some oats, and they have made bone and muscle, they are strong, they are fine, promising specimens. If you weaken calves the first year, they will never recover. I think it would be safer to breed these at fifteen months than some that are weaker.

Professor BROOKS. I would like to ask if the flax-seed meal is mixed with the skim milk?

Ex-Governor HOARD. Boiling hot water is turned on, and it is mixed with skim milk. Don't use the ground flax-seed continuously, or it will be too great a laxative; but it is a splendid thing.

Dr. LEARNED (of Northampton). In relation to the question of tuberculosis following the breeding at two years or three years, in my judgment, there is but one opinion to be given with reference to this. The principle is the same

in the bovine as in the human race. The power of resistance in the individual of the human family and in all the lower animals is what enables them to come to their maturity without the attack of tuberculosis. The lack of resistance is what causes us to fall under tuberculosis. There is no doubt in the mind of any man giving his attention to this, giving his thought to it, or, even if he has not observed, his reasoning faculty will tell him that a three-year-old animal is more mature, better endowed with resistance than a two-year-old animal. A woman at twenty-five years of age or twenty-two years of age is more mature than a girl of sixteen. The one put into the sphere of hard work, work of any kind, or called on for maternity, at sixteen will fall very much more readily under tuberculosis than another at twenty-two or twenty-five. We have reduced the vitality of men and women to-day by forcing in the early part of life, starting in the kindergarten and primary schools, graduating at twenty or twenty-two, coming out with a diploma and with the evidences of culture and what we call education. We are being convinced that we have made a great mistake; and no greater mistake is made there than is made by the dairyman when he urges his animals on under high pressure at two years of age.

Maj. HENRY E. ALVORD (of Washington, D. C.). Referring to this matter of the age at which dairy animals should be bred, I have the record of three years of work not more than thirty miles from Briar Cliff Farm, and with the same class of animals, but with a much less number, where there were very different results. We found that by proper care and rearing the Jersey heifers were as mature, as well prepared for their life work as dairy animals, and as resistant to disease, at two years of age as they were at three. We found our percentage of non-breeding animals more than double, as the result of trying to hold them to three years before their first calf. We found a considerable number of cases of those animals coming into milk at two years of age, in spite of us. I remember one year having a heifer at the New York State Fair that made a pound of butter a day on the fair ground, and yet she didn't have her

first calf until a year afterwards, and we had no end of trouble. I haven't the slightest question in my mind that one of the characteristics of the Jersey and Guernsey cow, the result of more than a century of careful breeding in their native isles, is to make cows of them at two years of age; and that it is going backwards, wasting time, to undertake to change this now from two to three years. I certainly should not be willing, from such data as I have available now, to undertake, as a rule, to hold animals three years for their first calf, instead of bringing them in at two years of age or thereabouts.

Prof. F. S. COOLEY (of Amherst). I take it the resisting power of animals is more dependent on the treatment for the first two years than it is on the age of the animals. A two-year-old heifer, under proper treatment, may be equally resistant to a three-year-old. I believe it is truly stated that the average of barrenness is increased by delay of breeding beyond the natural time.

I want to say one thing more in endorsement of what the speaker of the afternoon has said. There is a prejudice amongst farmers against an agricultural education. I have known farmers who did not want their boys to follow in their footsteps. I have known others who did not care to send their boys to the Agricultural College, because they could teach them to milk cows and hoe potatoes and plant corn as well as they could there. There is this utter misconception as to what it means. We need to consider a little as to what an agricultural education is, — that it is to teach the boys to think, not to teach them to milk cows and plant potatoes, and other drudgery; but that an agricultural school teaches boys to think, just as much as a classical school teaches them to think, and fits them for the needs of the present and the things that will concern them in business life.

Mr. EDWARD M. THURSTON (of Swansea). In part of the address of Governor Hoard he alluded to his county agricultural school. We know that in this State quite a number of our large cities are appropriating money for textile schools, where they teach the young men and women to man-

ufacture cloth; and anything in connection with that is taught in those schools. Now, my experience and observation is this: that, if we take our children from our towns and put them into city high schools, we have ended their career on the farm nine times out of ten. If there is something they must study different from what they are getting in the high schools in the towns where they are, it may be something to solve the problem how to hold the children on the farm; and if the State and the cities are spending money there on the textile schools, isn't it fair to assume that the farmer should have something to offset what they are doing?

Ex-Governor HOARD. I have been a very earnest advocate of teaching the elements of agriculture in the common schools, for several years, and I have been pushing all my energies in that direction, but I ran up against two obstacles. One was, the great body of teachers were unwilling, because they did not know enough, as they frankly admitted. The farmer opposed it, because he was so afraid it would affect his taxes. But he is not the only sinner in Jerusalem, and it is not because he is a farmer, either. It is because the farmer finds his revenue small. Well, I have been pushing this thing along, and I finally got Professor Harvey, our State superintendent, to take hold of it, and we have held repeated conferences, and gone before the Legislature of the State, and we called the wisest and best of the teachers into the conference to see what could be done, and we have studied what has been done in France and Denmark and Switzerland, and had repeated correspondence with Horace Plunkett as to what is being done in Ireland, and we have come to the conclusion you have to teach the teacher first. Therefore we went before the Legislature and asked for these training schools, and the first six counties that would make the appropriation should be placed on the list for State aid; and it was left with these counties whether they should do it, and they are being built. Professor Harvey has put it into the curriculum of the normal school, and every teacher that passes the examination must pass an examination in the elements of agriculture; and we

sent to Professor James, who has written, I think, the finest text-book that I know of. But a text-book isn't enough. You must have a teacher. I would rather have one teacher, filled with the knowledge and able to impart it, than all the text-books in the world. But we need a text-book to help the teacher, and this is the best one. We bought a hundred or two, and distributed them among all the teachers. And so we have been working and pushing the thing along in this way. Then we had the Legislature pass a law providing for two county agricultural schools, which should be, in a sense, you might say, miniature agricultural colleges; and the first two counties that appropriated money to establish those agricultural schools to be put on the State list, and the State supports the schools after they are established. Well now, it will require about \$20,000 to establish such a school, with the building and the necessary land. The counties have done it, and the county of Marinette, way up in the woods, was the first. I went before our own county board and pleaded with them, and they halted and hesitated until these two counties had stepped in and filled the breach, so we will have to wait until another year. I think at the next meeting of the Legislature they will enlarge the number, and will make appropriation for four another year, and six the next, and then ten; and by and by begin to turn this agricultural teaching towards the people, — not turn the people towards the school. We can't get the farmers to the agricultural college. We have about 400 boys going to the through course; and, do you know, we can't get the farmers to send their boys to take the four years' course in the agricultural college. But we can get them to take the through course. They go to the school and have about three months of study, and then they are taken through the State, a whole lot of boys, and there are medals offered, — I offer a "Hoard's Dairyman" medal for the boy who is the finest judge of dairy cattle, and another man offers a medal for the boy who is the best judge of sheep, and another of swine, and so on until there is a host of medals, — and the boys go out and visit the different herds in the State, and the railroads take them, — the rail-

roads are enterprising, — and the boys go and visit the herds, and they proceed to judge the animals. Then there is a set of judges to judge the judges, and those judges decide upon which boys or young men are deserving of this, that and the other medal. We should build up *esprit de corps* — pride.

An old Irishman built a ditch for me, and it was such a perfect piece of work that it filled me with admiration ; and I said, “ O’Brien, that is a ditch fit for a king.” And the old man took off his hat, and said, “ Sir, the O’Briens were kings once.” That was a grand spirit. He had not forgotten that way back in the history of the sixth and seventh centuries the O’Briens were kings of Munster and Leinster, and he took pride in digging the ditch well. That is one of the things I feel as though we lacked, — this spirit, this pride, that we need as farmers. No wonder men sneer at the farmer, because he is trying to sneer at himself all the time. “ I don’t want my boy to work as I have.” Is there any reason why a boy should not work, as well as his father? The mother says, “ I don’t want my daughter to work as I have worked.” Is there any reason why a daughter should not work, as well as her mother? What a degenerate daughter of a worthy mother would she be. I want the day to come once more when the American farmer will be the peer of any man on this globe, and we must begin with the boy. We must do something with the coming generation to hold these farms and keep the farms against the stress of the current of the outside relations and things ; we must begin and reach down at the boy, the child. We have the farm school and the district school. We must begin to sow the seed of education, and the boy will see that there is something in farming beside unrequited toil. We must show him that it offers some scope for the use of his brain, and that when he looks at an animal he is looking at the product of the genius of the Almighty.

A man wrote me a letter the other day, asking me to come up and help him out, and he said, “ The more I study this cow, I think it is most mysterious.” I answered him that from the days of Hippocrates and Aristotle down to the

present time the brightest intelligences of all the nations had been striving to understand the human mother, and that they had built great hospitals and colleges, and still they don't understand the human mother; and the bovine mother has just as much mystery in her as the human mother. Is it possible that we shall suppose, with all this study, that the great and mysterious functions of motherhood can be understood so easily and flippantly as we have? No. It is time we began to dignify these mysteries, and consider them in an intelligent, serious and reverent spirit. I believe we have already recognized this idea of education, and we have a right to say that the university and the college, instead of being fructified by the common school and the high school, should begin to turn its efforts upon the fructification of the other ways of education. There is no such thing as higher education, because the truth is correlative. What we need is wider education. Men gain knowledge as they gain land. The man is a fool that buys land and separates it so far that he cannot handle it economically. The man is wise that puts his facts against facts, and keeps spreading out fact related to fact. So the man is wise that buys land next to his home, not land that is too far away to be economically farmed. If he wants more land, buy that next to him. Did you ever hear of a man buying a farm on account of its altitude? No. What we need, my friends, is the idea that there is a wider education; and this idea of the higher education has prejudiced many common, plain people. They think there is aristocracy in learning, and they think there is arrogance in learning, and there is, because there is many a ninny to-day who has been carried through college, and puts on airs. We don't want arrogance in learning. We want that man should seek the kingdom of God and His righteousness, and all things shall be added to him; that a man shall seek true knowledge and truth, and that the truth shall make him free. It is knowledge of the truth that makes men free. It is error that enslaves free men. It is error that is enslaving the farmer to-day. We need intellectuality in agriculture. What is the matter with the farmer to-day? He does not feel a

thirst after knowledge, and desire it. Why should he not desire it? Because he has not been brought into contact with it. That is why I want to see his intelligence stirred in Massachusetts and Wisconsin; and I probably shall lay down my bundle long before the fruition of these hopes, but I think we have already got the matter stirred up, and we shall have something done by which men may be schooled in the common relations of life.

Adjourned.

EVENING SESSION.

The meeting was called together in city hall at 7.45 o'clock in the evening by First Vice-President Sessions, who said: We are privileged in having with us to-night a gentleman who has given much study to the subject of the evening, and can doubtless interest us. I have pleasure in introducing to you Dr. C. F. Hodge of Clark University, Worcester, who will now address you on "Nature study and the need of agriculture in a system of public education."

NATURE STUDY AND THE NEED OF AGRICULTURE IN A SYSTEM OF PUBLIC EDUCATION.

BY C. F. HODGE, PH.D., CLARK UNIVERSITY, WORCESTER.

Antaeus was a giant, the son of the sea and the earth. Hercules was a hero, the son of the heavens. Hercules and Antaeus met in the plains of Lybia, and such a wrestling match as they had the world has not witnessed before nor since. But even Hercules could gain no advantage over his antagonist, until he discovered that whenever Antaeus touched his mother earth he renewed his strength. Then Hercules lifted Antaeus bodily, and strangled him in mid air.

I never see the tenement houses of our cities built in solid rows, wall against wall and house against house, —and not only that, but one above the other, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve and thirteen deep, —that I do not think of that old-time wrestling match, back in the dim light of mythology, on the plains of Lybia.

Why did Hercules kill Antaeus? Why might it not have been a match for sport? Why might it not have been a comedy, rather than tragedy? Yes, why not? Simply because a myth must tell the truth. A myth must tell the bottom truth, must express the very quintessence of life and human wisdom, or it could not live in the hearts of men and be a myth. Furthermore, Antaeus was uncivilized. He compelled every man that came to Lybia to wrestle with him, on pain of death if he were thrown. So it was back in the dawn of mythology, and so it is now. Man's struggle has been fiercest and most tragic with the savagery of his own species. The struggle of mankind with wild beasts is nothing compared to it, and is now little more than sport.

It is a law of biology, of general application, that the struggle for existence is severest between species most nearly related, — species that require the same or similar foods and other means of subsistence. In this way connecting links between related species have been broken up and lost, — have become “missing links.” Gaps have been made wider and wider, and the higher we rise in the animal scale the wider the gaps become: that is, lowly organized creatures live along without much struggle; species that are higher in the scale, and are rising, growing, changing, developing and evolving, are struggling hardest. As long as this contest remains on the plane of brute force, there is no possibility of sentiment or even of a moral code stepping in to mitigate its severity. The moment we cross the threshold of the moral law, which works for the greatest good of the greatest number, the old struggle is transformed into the mutual effort to help one another. But the “white man’s burden” is no idle fancy. It is a law of life, and between the civilized and the uncivilized there is no middle ground. Walls or rivers, mountains or oceans, avail nothing. Between savage and civilized, between men who do and men who do not accept the moral law, the struggle has always been, is now and ever shall be, until every spot on the green earth is a safe place for a good man or a good woman to live.

Well, you ask, what does this have to do with nature study? It is the bottom of the whole matter. In other words, I find the foundations of civilization in the relations to nature that mankind have found necessary to develop. The need of agriculture in a system of public education I trace directly to the role agriculture has played in the process of becoming civilized. And it is certainly the part of wisdom to attend to the barbarism within our own borders before trying to cope with that in the uttermost parts of the earth. What, then, has been the influence of agriculture in the life of the race?

Biologists sometimes ask us to begin farther back, with an agile and highly crafty animal that lived chiefly in the trees; but I shall not expect you to go with me as far back

as that. Let us begin with savage times. Here we find man living in natural caves, in temporary shelters, or often in the open, like the beasts of the field. He lives in small tribes, families or clans, and subsists by hunting and fishing, by gathering natural fruits. He clothes himself, when necessary, with the skins of animals. Food is often scarce, and periodically his numbers are decimated by famine. His warfare with the wild beasts at this stage results in much loss of human life; but this is trivial, compared with the ceaseless conflicts between rival clans and tribes of men. This is the chief reason for the very sparse population of savage countries. One savage man can hardly eke out a wretched subsistence in a range of territory whose natural resources might support a thousand civilized persons in comfort. In a word, the life of the savage is chiefly a brutal struggle against all nature, including his brother man.

The first great step upward from this condition of abject savagery was domestication of animals. This I consider to be elementary zoölogy for public school courses in nature study. Says Professor Shaler on this topic: "From this point of view our domesticated creatures should be presented to our people, with the purpose in mind of bringing them to see that the process of domestication has a far-reaching aspect, a dignity, we may fairly say a grandeur, that few human actions possess. In a large way the work of domestication represents one of the modes of action of that sympathetic motive which more than any other has been the basis of the highest development of mankind." The essential value in the process is found in the development in the men who did the work of sufficient intelligence and sympathy with nature to discover friends and helpers among the animal life about them. The dog was the first animal domesticated, and this is still the idol of the child's heart. Then came the horse, horned cattle, sheep, poultry and swine, — almost all of them before the dawn of authentic history. The latest acquisition, according to Professor Shaler, is the turkey, which was taken to Europe about four hundred years ago, domesticated, and later brought back to this country.

Think for a moment what the domestication of animals signified for civilization. First of all, it meant a larger intelligence, a new philosophy of life, a higher relation to nature. Materially, it assured a better and more abundant food supply, and consequently larger and more powerful tribes, *i.e.*, higher human relations. In long struggles small margins of strength are decisive; but think how human power was multiplied in the tribe that first domesticated the horse. This was probably done by some branch of the Aryan race in the north of Asia, and in that act the die was cast for the conquest of the world by that tribe.

Important as domestication of animals has been, important as it is still, — for we should, as an intelligent people, take up the work again and carry it on until every useful species is brought under dominion, — the greatest step of the race, the essential advance which marks the transition from barbarism to civilization, from wandering nomads to stable, civilized, populous communities, is cultivation of plants. In the stability of landhold we have the beginning of home as distinguished from the casual camping ground: and until this takes place we have no name for either home or country. The very essence of the ideas of home and country is involved in the planting of something in the soil.

In all matters relating to life and its environment, the shuttles of cause and effect fly back and forth so fast that we can hardly distinguish between them. This fact goes far towards explaining away the ancient antithesis between being and doing. Being and doing are really the two sides of the same shield. Let us be something, and we will do something, and every good act makes us better and stronger. The moment man planted about his home, he began to grow mentally and morally. Willingness to work for his daily bread and for that of his family, intelligent provision for the future, love of home and country and the courage to fight for them, — patriotism, — are among the virtues developed and established by this work. When our school system was first planned, as has been often pointed out, we were an agricultural people. The home supplied this fundamental education, as some of the boys and girls may have been in-

clined to think, in superabundant degree ; so that the school at first was invoked to supply a knowledge of books and letters. But, with a yankee distrust in “ book larnin ” that has become proverbial, it is strange that it has ever been permitted to usurp the whole field of public education. In the mean time, the old New England home has changed, and the rich education it used to supply has largely fallen away.

In ancient mythologies, even, the fact that civilization began with agriculture is clearly expressed. Osiris, the great divinity of the Egyptians, is said to have led them from barbarism by teaching them how to till the rich valley of the Nile. The same is true in ancient Greece and Rome. The divinities Demeter and Saturn performed a similar service, and were deified ; but their worship degenerated, and the people flocked to the cities : and neither the works of their poets and philosophers nor the examples of their kings could save those ancient civilizations from decay.

The fact that a race or tribe have taken up the work that nature presents to them, have solved its problems and become civilized in the process, is a mere matter of logical sequence. Man must first subdue the wild beasts of the earth, in order that his family may live in safety. He must domesticate animals, and finally till the soil, in order to gain support for populous communities, with their varied commerce, arts and sciences. And it has seemed to me that what is true for the race by logical necessity must be true in a large way for the individual as well.

Of course we should be careful about drawing too sweeping conclusions, but recent studies of criminals have tended to show that their education has been defective, in lacking the civilizing influences of animal pets. The modern tramp seems to be a nomad in civilized society. My own studies, as far as they have been made, have indicated that here, too, we have to do with a fundamental defect in education. The tramp, I have found, is almost to a man a person who has never planted a seed in the ground and reared a plant. He has never gained a fundamental idea of the resources of nature from being a producer himself. He refuses to work,

because he has no feeling of power or resource within himself.

These fundamental things, then, that we find underlying human progress, things that constitute the real nature study of the race, should be given their place in the education of the child. How far is this done in our modern school system? I fear, instead of welling up out of the deepest and richest experiences of mankind, our elementary science courses have sifted down like dust and ashes from the pre-occupied heads of pedagogues and logicians.

We first had so-called "elementary science lessons," so well taken off by Dickens in the first pages of "Hard Times," a Thomas Gradgrind, Mr. McChoakumchild, affair.

"Bitzer," said Thomas Gradgrind, "your definition of a horse." "Quadruped. Graminivorous. Forty teeth, namely, twenty-four grinders, four eye teeth and twelve incisive. Sheds coat in the spring; in marshy countries sheds hoofs too," etc. "Now, girl No. 20," said Mr. Gradgrind, "you know what a horse is."

Possibly we flatter ourselves that we have gotten beyond this stage. We shall see in a moment.

The next attempt of promise was the "object lesson," with the motto, "Teach the children things, objects, realities." A very good idea, if we teach them the right kind of things. I hope you all may have heard James Whitcomb Riley give his recitation on the object lesson, and if we are to spend the time discussing the complexion of a "blond" or "brunette" peanut, the "object lesson" may be a ridiculous waste of time. So the object lesson, about which we heard so much a few years ago, has gone by the board.

The latest movement toward education of this kind has hit upon the happy name "nature study." It would seem that the very words carry the suggestion of a natural, wholesome instruction. They contain in themselves a remonstrance against the forcing of elementary science upon too young children, and they lead us away from the dead mechanicalness of mere "objects" toward the living realities of nature as it surrounds the child. This new movement has brought new life and hope into the educational field; but alas, the

dry-as-dust pedagogues have again come in to kill it with their books. Since nature study has come to the fore these have not been lacking: but after following their rapid appearance for the past five years, I am forced to confess that I have not been able to find one that I should be willing to have a child of mine follow.

John Burroughs is a doughty farmer, and the finest student of nature we have, and he says: "Of the books upon nature study that are now issuing from the press to meet this fancied want of the schools, very few of them, according to my thinking, are worth the paper they are printed upon. They are dead, dead, and neither excite curiosity nor stimulate observation." *

It will take but a few minutes; and, in order that we may understand one another better, and at the same time learn something of the plans of nature study now in the field, permit me to read a few sentences from two or three books that I have brought with me. They are among the latest books on the subject, and may be fairly considered to represent the views of present leaders in this new movement in education. You may object that it is hardly fair to judge an author's scheme by such brief citations, and this is true in a measure. Still, a book, like a chain, is no stronger than its weakest link; and moreover, I shall endeavor to select passages that fairly represent the methods and stand-points of the respective authors. While I criticise the books, I do not wish to introduce elements of a personal character, and so shall not, unless requested, name their authors.

This first book bears the copyright date 1895. On page 97 we find the following:—

BONES. FOR HIGHER GRADES.

In the preceding articles on this theme bones have been studied by putting them *into the hands of the children*, and by requiring a careful study of each bone, its shape, size, structure, and adaptation to the purpose for which it was intended. The lowest pupils strung them like beads, or glued them to cards, putting together

* "The Outlook," Feb. 4, 1899.

the feet and wings of animals. The chicken foot and wing, the simplest structures of this kind, were prepared by lowest primary or second-year pupils. . . .

Where a school has a skeleton of a dog, the subject of bones may be taught almost as well as if it were the skeleton of a man instead. I have known pupils to become so enthusiastic in the study of bones that on Saturday a knot of boys would gather in some grove or meadow to boil a dead animal for next week's study. For many useful hints in regard to work with bones, I am very greatly indebted to Dr. —.

Here we have a half-baked medical student, himself doubtless enthusiastic in his anatomical studies, putting work that belongs in a medical college into the primary grades of a public school, under the name of "nature study," — a single case, which shows the present chaotic state of our elementary science teaching.

Take another more recent book, "Nature Study and the Child," — a most attractive title. It comes to us from one of the foremost normal schools of the Empire State. It contains 618 pages of fine print, and represents a complete system of what the author would have us consider "nature study" is in its relation to the child and elementary education. The book begins well: —

"Flower in the crammied wall,
I pluck you out of the crammies;
Hold you here, root and all, in my hand,
Little flower; but if I could understand
What you are, root and all, and all in all,
I should know what God and man is."

The chapter ends well, — 37 pages further on, — with the same quotation. The author then proceeds to learn "root and all, and all in all," with the most wooden vengeance. He digs up a dandelion, and begins with the root. After describing this in detail which would do credit to an instructor of college botany, he says: —

We describe the dandelion root as a tap-root, cylindrical or conical, exogenous, containing a milky liquid.

He next works out the leaf in the same manner, and says : —

We can, then, describe the dandelion leaves concisely as radical, alternate, runcinate, pinnately veined, glabrous.

The flower is then taken up, and he says : —

We can describe the dandelion blossom, using the terms above defined, as : Growing on a naked, hollow scape, composite, with an involucre of (usually) three rows of imbricated linear green bracts, the inner longer row erect, the outer rows reflexed. Individual flowers arranged in a close head. Parts epigenous, borne on a short beak. Calyx a pappus of many fine white hairs. Corolla yellow, strap-shaped, with five teeth. Stamens five, epipetalous, syngenesious. Pistil one, with one-celled, one-seeded ovary (forming in fruit an akene), with a long style, two-cleft.

Ye gods and little fishes ! if any one claims that this is what Tennyson meant by learning “root and all, and all in all,” if any one maintains that this is “nature study,” and not college or university botany, — they have me to settle with, and to the bitter end. If such stuff as this is to enter our schools and be taught to the children, I know of one parent who shall feel compelled to send his children to some other country to be educated.

After the 37 pages of technical botany, with here and there a dash of poetry to redeem it, chapter II. follows with 50 solid pages on the rabbit, but not a snatch of verse to break the monotony. The life and habits of the animal are described in detail in the most wooden and mechanical fashion possible, and the chapter ends with a lengthy discussion of the comparative anatomy of bones. The picture of the skeleton, which you see on this page (showing), sags back in a scared-to-death attitude which has always put me in mind of Balaam's ass, when she saw the angel of the Lord in the way and refused to carry the prophet farther. I have often wondered why this did not occur to the author, and why he did not have his eyes opened at this point and turn back. He did not, however, but forged ahead for 500 pages more.

But, you ask, how does such work carry the test of

school-room use? I shall have time to quote to you but one teacher's opinion of it. After reviewing the book before a class of teachers, one of them said: "I was in the —— normal school when this plan was being worked out, and I know all about it." "We should all be glad to know how it worked," I said. "Well," she replied, "the children were simply bored to death with it. They fairly loathed the stuff, and the poor teachers were worn to the bone with it. I often used to tell Dr. —— that I could do much better teaching without any nature study at all."

I have one more book with me. Let us glance at it a moment, and then I shall try to tell you why I have come to talk to you about nature study: why, in fact, I have felt compelled to take a hand in this matter of elementary instruction, which is something quite aside from my regular work. This book is not called nature study, but is more consistently entitled "Systematic Science Teaching: a Manual of Inductive Elementary Work for All Instructors." It hails from the State of Illinois. The author's thesis is, in a word, that we can teach anything and everything to any and every child. As he puts it: "A child can be led to any height [and he should have added to any depth] if the steps are made short enough."

Here is a sample of his method:—

STEP V.—ANIMALS. ACQUAINTANCE WITH A FEW HOME ANIMALS.

The Boy.—Children know more about their own organs than those of any other animal. Hence begin here, and bring out the following points in preparation for following work:—

1. Where do boys live? (On land.) (All for this time.)
2. Can a boy feel? Where best? (Make tests on exposed parts.)

Here we jump from abysmal inanity to university psychology at a single bound.

3. Can boys hear? What with? How many ears? Where are they placed?

4. Can he see? What with? Where are the eyes placed? How many? What shape is the pupil? How is the eye closed? How many lids to each? Which way do the lids move? Any

other use for the lids? (Protect and moisten.) How are the lids kept moist, and from rubbing on the eyes?

5. *Nose*. — Where placed? Nostrils directed? Use of smelling?

6. *Taste*. — Where located? Why have we taste?

7. What ways of moving has a boy? In what position does he “creep”? How does he “swim”? Position in “walking”? How is the foot placed down in walking? How does running differ? How does he “climb”?

8. What limbs has a boy? How many legs? How many arms? How many toes? How many fingers? How many nails? Has he a thumb? What can he do with the thumb that he cannot do with any finger? (Place it opposite to fingers.) How are his legs and arms arranged? (In pairs.) (Punctuation is quoted.)

And so on for two pages more about the boy. Then we have: —

The Cow (No. 57). 8. Notice that she has four legs and a cleft hoof with two toes.

On reading this over to a bright school boy, he burst out at this point: “I should think the man that set type would have known better than to have put that in.” In another book by the same author, entitled “Advance Science Teaching,” we are told that the cow has four toes, which is the correct number, — a great “advance.” After about two pages on the cow we next study: —

The Hen (No. 37). Material needed: get the butcher to save a lot of heads and legs (which they usually chop off and throw away), wash them well, dry, and give one of each to every two or three pupils. Get some pupil to bring a live hen in a box, to have it for examination. A hen should have also been set about two weeks before this study begins.

3. Search for the concealed ear.

4. Find the three eyelids. Which way do they move? Gently touch the eye of a live hen with a feather, and see her *wink*. Notice the round pupil. Can a hen look *forward* without turning her head?

5. Notice the nostrils, where they are, and which way directed.

7. A hen walks.

8. The hen has four toes, with blunt claws. From the toes up to the first joint is called the tarsus. Is it feathered, or not?

10. Her food is a mixed diet of seeds, fruits, insects, etc.

11. Her lips are a horny bill.

14. She breathes *air* by lungs, and her body is *warm* and blood *red*.

16. She has an inside, bony, jointed skeleton. (See a cooked chicken.)

You laugh at this, but if you had pledged yourselves to renounce the delights of agriculture and to devote your lives to the pursuit of science, you would weep instead. It is such books as these that make science a by-word and a laughing-stock the length and breadth of the land. They have brought this newest attempt at natural education into disgrace. "If this is what you call nature study," say the common-sense people of the country, "let us cleave to the three R's and to classical education." I heard only recently of a superintendent in one of the rural districts of Massachusetts who asked one of his schools to find out how a frog winked, and tell him when he visited the school again. He nearly lost his job, which, to my thinking, speaks well for rural Massachusetts. If that same superintendent had asked the children to tell him how many insects a frog would take for a dinner, I do not know of a farmer in the Commonwealth that would have found any fault with the lesson.

New York State and California have taken hold of nature study more vigorously, perhaps, than any other States. New York, especially, has voted liberal appropriations for its promulgation during the past five years. Other States have naturally been holding back to learn the most approved methods and the results. Only a few days since word has come to me that the main argument that prevented the adoption of a nature study book by one of the middle States reading circles was, that nature study in New York State and California had proved a failure.

To save our schools from abject bookishness, to bring our children into normal and healthful relations to nature, to repopulate the rural districts and elevate the pursuit of agriculture, we need nature study as never before. And just now, when the trolleys are opening up the country in every direction, good roads are being built, and the cityward tide

is beginning to set back toward the New England hill farms. The dark day for the farm is past. The future is bright with hope, and what we need now is that public education shall do its part, shall equip the people who go back to the farm with genuine knowledge of the resources of nature at their command. Whether we shall call this instruction nature study or some other name, agriculture or horticulture, remains to be determined. But nature study is too good a name to abandon to the enemy. To me, nature study means more than agriculture or horticulture or elementary science, and it is more than all these combined.

In line with what was said at the opening of this paper, nature study should embody the fundamental relations and achievements that mankind has attained in the past, together with all that modern science is able to contribute which touches these fundamental matters. We saw that even the gods, Osiris, Demeter and Saturn, were agricultural gods. Moral and social virtues centred about the possessions which man produced from the soil. The very conception of home and country, with all that love of home and country has come to mean to civilized man, has sprung directly from man's relations to the soil. Governments and laws, the stability of the home in the marriage relation, the best social usages and customs, much of our finest literature, esthetic development in the creation of beautiful gardens to surround the home, — all these have grown up around man's relations to mother earth. Indirectly, as an outcome from the measure of material resource that the soil has yielded, have also sprung schools, education, literatures, arts, sciences. We need a nature study that shall be the old nurse to the child, as to the race, and guide his work and play toward becoming civilized, and toward making the most and best of all good qualities he possesses. What does counting the legs of a cow or the toenails of a chicken have to do with this? I fail to see the connection of such things as these with anything more fundamental than the science of comparative anatomy. It is a great science, but it is scarcely more than a generation old, and mankind got along well for thousands of years before comparative anatomy was born.

A number of European countries have begun to realize the importance of agricultural education, and school gardens are becoming a regular feature in the equipment of their schools. Norway, Sweden, Holland, Belgium, Germany, especially Austria, Switzerland and even Russia, have all gotten ahead of us in this important work. So essential has this instruction proved itself, that France, as long ago as 1887, passed an edict making it incumbent upon all who submitted plans for public school buildings to include a plan of a school garden in each, before the plan could be accepted.

There are some general matters in connection with the management of school gardens in Europe that would not work in this country, and it is well for us that they would not. The master of the school often owns the garden, and the pupils are obliged to weed and hoe, prune and bud and graft, and learn their other practical lessons, with little or no stimulus which comes from ownership of either garden or its products. While this plan may not meet with objection under imperial forms of government, it lacks the one feature which, to my mind, imparts the highest value to the work, and which, at the same time, we need most in this country. The ownership by the child of his garden and of his produce furnishes the best possible means of educating him, in a truly fundamental way, in the rights of property. How much, think you, would real estate in Massachusetts advance in price, if in every farm and city lot property rights in agricultural and horticultural property were sacredly observed? If every farmer and gardener in the Commonwealth could sleep of nights and go to church on Sundays with the feeling of reasonable security that his wood lot would not be set on fire, and that his orchard, garden or vineyard would not be molested, what would he not give? I have often thought, during my twelve years' sojourn in the State, as I have seen fruit trees cut down solely to save their owners annoyance, that property in at least the horticultural sections near our towns and cities would rise materially in value on the advent of such a millennial condition. And I think I am far within bounds of reason when I assert that,

aside from the value of civilizing the hoodlumism and savagery in our midst, the outlay in wise education would be repaid ten-fold in enhanced value of property alone.

Where are the peach orchards of which Massachusetts was justly proud a generation ago? We may say that the yellows have destroyed them. The yellows can be effectually dealt with; but there is a worse evil, which, so far as I have been able to judge, lies nearer to the root of the matter. Take three cases that may serve to illustrate my point. A year or two ago I drove several miles into the country to a place where I was told was a peach orchard of fifteen acres. I found a rolling pasture, with not a peach tree in sight. A whitehaired man told me, however, that he had had an orchard, but that the fight had been too much for him. He had been obliged to keep watchmen patrolling the place night and day, and even then his trees would be torn down and carried off. In another instance the man still had his orchard, but told me that he was obliged to protect it in the same way, and he showed me the rifle which he used to frighten away intruders. He was about eighty years of age, and it was plain that this battle would go the way of the first. An accidental visit to a third orchard disclosed the fact that the night before thieves had cut a wire fence, driven into the orchard, and loaded a wagon with the choicest peaches, ruthlessly breaking and destroying the trees.

I do not need to multiply examples; you know them too well already. What are we to do about it? The prisons are full to overflowing; the law and police, preaching and punishing, have reached their limits. I could go even further, and show that this whole repressive philosophy of public control is uncivilized, and tends to create the very condition of affairs which it seeks to alleviate. Others have done this better than I possibly could. But ask yourselves this one question: What reasonable or possible foundation in his own character can a child have, who has never worked, produced or owned anything himself, for respect of the ownership rights of others? How can we lay this foundation in the child's character? The surest way, as it seems to me, is

to follow the method by which the race has developed it. If the children of a neighborhood make the raising of fruits and flowers impossible, a far better remedy than is afforded by police consists in getting them interested in rearing fruits and flowers of their own. After a child has once done the work, he will feel instinctively a regard for the rights of others that nothing else can give.

Since agriculture gave rise to and established the home, since love of home is one of the highest sentiments of human life, and since from this we find the fountain head of love of country, of laws of property and of social morals, I am impelled to make the home garden the centre of my plan of nature study. We shall need the school garden too, for class lessons and demonstrations, and to furnish materials for drawing and general study, so that this may be obtained fresh and at suitable times without trespassing on private grounds. I shall speak of that later.

When we analyze for ourselves the sentiments and memories that cling about the home of our childhood, do we not find that the fondest memories attach to the immediate surroundings of the home, the trees and flowers that made it beautiful, and especially the garden which yielded so many of our childish delights? Let us ask ourselves whether we would have these wholesome sentiments and memories lacking from the lives of our children.

I am aware that my topic is not new. In the address of the Rev. T. D. P. Stone, "Transactions of the agricultural societies in the State of Massachusetts," 1849, I find the following: The address is entitled, "Means to be used to create a deeper interest in the cause of agriculture." It was awarded a prize of \$25 at the time:—

Why should not our New England schools, so justly our pride, so truly our defence, impress young minds with a taste for cultivating fruits and flowers? . . . Our Maker has given children a taste for the beautiful. He has given to cultivators of the soil the power of rendering their fields, and orchards, and gardens beautiful, without detracting from their profits. Still, the farmer rarely thinks of anything but profit, and regards attention to taste as so much wasted effort. "Flowers," said one of Hodge's descend-

ants, "Flowers are curses, young gals will stick 'em into the ground, and afore they are big enough to make butter or weed onions, the paltry yellow and red, and speckled blossoms will be peppered like Canada thistles, all over the garden patch, and whole home lot." But Hodge, with all his hostility to flowers, does not receive larger profits than his neighbor, whose grapery and tomato-bed, and fowl-yard, and hive-house, increase his cash as much as they add to the beauty of his premises, although their mutual arrangement amid roses and dahlias have the appearance of a mere pleasure garden. Hodge will have to look for his children, bye and bye in some city, while the latter family mentioned will only have remained, like the people of the apiary, to occupy and adorn contiguous homes, and give to the whole neighborhood the aspect and fragrance which enchanted their young years. When we look at the utter want of regard to the idea of rendering agriculture attractive in our common school arrangements, we must cease to wonder that there is so much migration from our favored State. We call it the spirit of adventure. Is it not, in part at least, the spirit of disgust? How, then, shall a change be brought about?

After fifty years the same question confronts us, and its solution, which Mr. Stone sought in proper education of the young, is, if anything, even more imperative now than it was then.

Hodge has long been seeking in the cities for his children, but lo, they are not. Our vital statistics are much complicated by foreign immigration; but it is probably safe to say that among our strictly New England population there are more deaths than births. We often hear France alluded to in this connection, but official statistics for New Hampshire, 1892, show that to every 1,000 inhabitants there are 19.1 births and 20.1 deaths. In France the ratio is 22.1 births to 22.6 deaths. As a whole the New England States stand third lowest among the nations of the earth. The birth rate is 24.9 per 1,000 population. France has a birth rate per 1,000 of 22.1; Ireland, 22.4; Germany, 35.7; Hungary, 40.3. Despite her lower death rate, New England also stands third lowest in increase of population from this vital source. From strong families of from six to twelve children we have dropped in a single generation to families of one, two or none; so that writers

abroad are pointing to New England as the most glaring example of sudden racial degeneration on record. And why is it that, with our few children, we see so many advertisements, "House to let to family of adults?" Is it not because children are not properly trained, are idle, and consequently mischievous and destructive? Give the children interests and wholesome work to do in upbuilding the home, and they will not tear it down. Where even a little land is available, the problem may be solved in such wise that these advertisements will be changed to read: "House to rent to family with two or more children; no family without children need apply."

As an educator of the child, the home garden contains possibilities that have never been appreciated, and the prime factor in realizing these possibilities is ownership by the child of what he produces. I know the garden is a painful theme to some, and we have to thank, for much of the neglect of the modern garden, the slavish drudgery, the punishment by stents of weeding and hoeing that some of us remember. But give the child appropriate rights and responsibilities of ownership, and the garden becomes at once the prime source of education in citizenship and the laws of property. Furthermore, we need much closer relations between the home and school, and the home garden can be made the great text book from which the child may learn his lessons in nature study. Nature study in the school would thus add interest to the work of the garden, instead, as is too often the case, of turning the child away from these wholesome pursuits by sheer neglect.

Each home will approach the problem in its own way. On the one extreme we shall have all flowers, lawns and ornamental planting; on the other, potatoes and cabbages in the front yard; and between the extremes, all degrees of blending the useful with the beautiful. I have planned with my own children to give each one a plot of ground, beginning at the age of four or five, furnish each a seed box of his own, and necessary tools, with places to keep them. I then get flower and garden catalogues for them, and let them study and plan, and finally decide what they

wish to plant. Then comes the daily lessons, the necessary help over the hard places, the encouragement, the instruction as to preparation of the soil, and best ways of planting, of dealing with the weeds, fungi and insects, and so on through the list. I challenge all the books in the world to yield such fine education as this. If the child chooses to raise something of real value, I shall pay him the market price, and encourage him to start a savings bank account in his own name. I want each of my children to rear a peach, plum, cherry, apple and pear tree from the seed, and learn the methods of budding, grafting and pruning, and, as well, study the culture of our best varieties of small fruits, — grapes, raspberries, blackberries, currants, gooseberries and strawberries. I want them to learn, by doing the work themselves, the rearing of roses, lilies, moonflowers, bedding and annual flowers, shrubs and vines that may aid in making home the most beautiful spot possible, — a place that we shall not want to leave every summer. Since the purpose is mainly educational, I shall want the children to originate plans and designs, and take responsibilities as fast as practicable. In this way the work will embody throughout a part of their spontaneous interests, and become truly a part of their lives, a part of themselves. As the years go by, I shall gradually increase their properties, giving to this one a tree to care for, to that one a trellis of grape vines, until practically all the nature study property of the home is passed into their hands and control. And I will warrant that the genuine education and civilization they get out of it will prove of more real worth to them for life than any other one feature of their education. It should also be borne in mind that, instead of detracting from any of the opportunities and advantages of more formal education, it will supply the best possible foundations, — the cultivation of heart and will, of patience and powers of observation and reasoning, upon which other lines of education may build.

On the material side, I figure that a boy between six and twenty-one, given a moderate-sized garden, can actually produce property of his own to the amount of one thou-

sand dollars ; and that he can be led to do this without compulsion or drudgery, with only such exercise in the fresh air as he needs, and without trenching on his school hours or on the time he ought to have for play and recreation. In the end, he will have solidity of character, regard for the dignity of labor, sincere respect for property rights of others, which every member of a republic should possess. By having grown naturally into its responsibilities, he will be the better able to found a home of his own.

By means of the school garden we may reach and rejuvenate homes from which garden lore has lapsed, or is in its last stages of decadence. Had you been able to watch for the past four years, as I have done, a little experiment of this kind, I am sure you would feel, as I do, that such work should be made a part of the nature study of every school in the Commonwealth. The experiment consisted in taking a package of flower seeds into a school, some time in March, and in asking the children how many would like to take a few seeds, and see who can raise the best plants. Prizes for the three best plants in each room were offered ; and, in a neighborhood where the children are honest (I should say where the parents are honest), this feature enlivens the work, and I have no objections to it, but prizes are not essential. I know it would do your hearts good to see how the children go into a game of this kind. At first one or two hung back, but for the past three years every child in the school of about four hundred pupils took the seeds and tried to rear the plants. Each child promises to take the sole care of his plant, and to bring in his result, whatever it may be, for the flower show at the end of the term.

The first year we did not tell the children what kind of seeds were given them, — simply in order to quicken their curiosity, and set them to guessing and studying. The result was that we had at the end of the term a most beautifully grown collection of weeds. In the highest grade, to which petunia seeds had been distributed, the children had nothing but weeds, — not a petunia plant anywhere to be seen. I confess my first feeling was one of chagrin, espe-

cially since I had invited several prominent members of the Worcester County Horticultural Society to judge the plants and award the prizes, and they laughed at me. On thinking the matter over, however, it became the most interesting flower show I had ever seen; it woke me up thoroughly to the need of such work. I never realized before that we are raising up children by the thousands in the tenement districts of our cities who have never thought of planting a seed and rearing a plant. Many of these children, almost all of them, in fact, had never in their lives planted a seed of any kind. Again, how much power to observe and reason had they developed? Their yards, from which they had obtained the soil, were full of weeds; the soil was full of weed seeds. They had not thought of that. They did not have reasoning faculties enough to compare the weeds in their flower pots with those in their back yards. Twice during my sojourn in your historic State I have had fine beds of mignonette, and they were not weedy, either, cut even with the grass by men who pretended to know enough to mow a lawn. It was done the second time after I had pointed out the bed to the man, and cautioned him against injuring it. He was very sorry, and said he "forgot all about it." The matter was explained now.

After the first year we told the pupils about their seeds, and gave them lessons on weeds and on preparation of the soil and methods of planting; and the flower shows have grown in beauty and interest from year to year. A school garden was next made, and trees and flowering shrubs have been planted by the children in their school yard. Over eighty per cent of the children, as a result of the work, started gardens of their own at their homes. I have been informed by a resident in the district that juvenile vandalism had practically disappeared from the neighborhood. As a natural result of their garden work, children must become interested in the study of insects, in insectivorous animals, toads, birds and bats, and in the various fungi that attack their plants.

We hear a great deal of complaint about overcrowding of the school curriculum; but is not this due to confusion

and lack of proper co-ordination among the different subjects? If we introduce a clear purpose, such as is furnished by the fundamental relations of mankind toward nature, this will co-ordinate and unify the subject matter, throw out such as is useless and irrelevant, and condense and inspire with life our whole system of elementary education. Knowledge of the things that touch life closely is easy and natural, and makes life stronger and better. Ignorance of things that we see about us every day becomes positively painful, unless the mind grows so dulled by the pain that it ceases to perceive them.

If the children are actively engaged in their home and school gardens, they can easier than not learn about a number of the important insects, the common birds and other animals in a manner that will greatly help them in their work, and fill their after lives with interest, satisfaction and enjoyment in the life and nature about them.

It is very little that I have been able to say on so large a subject, and many topics which I had hoped to touch upon I must omit, since I see that I have overstepped my time. I hope we may succeed in bringing people to realize that nature study is a subject of the greatest importance, not only to our public education, but to our social life as well.

Mr. A. M. LYMAN. The lecture reminds me of a little boy who wanted some maple sugar, and went and asked his grandfather for the privilege of tapping a maple tree in the front yard. Permission was given him, but instead of getting any maple sugar he came into the house bringing in what he said was nothing but water. Another child, not five years old, I have seen bringing a horn bug into the house which she had been harnessing with a little string. The string slipped off, and she wanted it tied on tighter: she had got a horse. Speaking of domesticating animals, there was a little brood of toads about the house that knew when she was ready to feed them.

Prof. GEORGE T. POWELL (of Briarcliff Manor, N. Y.). I want to express the very great pleasure which it has given me to listen to this address this evening. I believe it is the

key note to the revival of the agricultural interest not only in New England, but the entire United States; and I want to comment particularly on a point which the doctor has made, — that the danger of the whole theory of nature study as advertised to be instructed in the public schools lies in just such trash as these text books from which he has given us illustrations to-night.

It was my privilege to do something in nature work in New York State a few years since. In conducting the farmers' institutes for New York, one special thing which I discussed at every institute held in the State was the position which the public schools of New York State held in relation to agriculture, and the introduction of nature study in the public schools, the application to be made directly to agricultural life. I was called upon by people interested in educational work in New York City to demonstrate practically the value of nature study in the schools. I chose one county, Westchester, in 1896, to give a practical demonstration of how nature study could be introduced from the practical stand-point. I had the assistance in this experimental introduction in the schools of New York of one of the best teachers at Cornell, Miss Anna B. Comstock, and also of Prof. C. C. Curtis of Columbia. While a college professor, he knew just how to reach children, and with this very able support I started this work in the schools of Westchester County.

We went into the schools, and took fifteen or sixteen minute periods in the study of the plant, the animal or the insect; and I want to give one illustration, — the presentation of the study of a plant. I took the strawberry as an illustration, and just gave a sketch of this plant, gave something of its habits of growth and some few points in relation to the blossoms upon the plants, and in a very few moments just gave instruction on how to set the strawberry plant and how to deal with it in the soil. At the close of the work in each school I made this offer, to each pupil who would be interested the next spring to pursue the study of the strawberry plant, that, on application made to me by mail, I would send each one half a dozen of the plants; to

remember the instruction of only fifteen minutes, and take the plants and deal with them; and I made a little further obligation, — that what they had learned they should bring to school in the form of a letter, telling their fellows what they had learned, each one. Now, what was the result? Quite a number said to me, “You will not hear from one of these children. If there is anything a child dislikes to do, it is to write a composition. You have defeated your whole work by placing the obligation on them to bring to school the few points they have learned.” The following spring I was overwhelmed, near the middle of April, — my mail came in completely loaded down with applications for strawberry plants. Not only from the schools in Westchester County, but the New York papers had published this offer, and you know how children read papers. The children of New York City supposed they were included in the offer, and I had two thousand applications from New York City children for strawberry plants. Every child got his plants. In other parts of the State papers had copied the offer, and the children all over the State supposed they were included, and I got applications from almost every county in the State of New York. The result was, when I had finished the work I had sent out over twenty thousand strawberry plants. Exactly upon the line we have had here to-night, those children went out and did something. That is the kind of teaching that is going to be of value, — to give the children something to do.

Concerning these compositions that came back, here is one illustration. A boy in New York City wrote in the month of August, saying: “The plants you sent me have multiplied. I have so many new plants that I feel confident I can do something if I can rent a little piece of land outside the city, and raise fruit and send to market and help my mother pay the house rent.” The boy did rent the land. He set out two thousand plants, and made a success of it, and helped his mother pay the rent. There was one of the fruits, and I might mention many others. Those text books are entirely inadequate to the needs of the schools, and we have been interested in the presentation of the question

to-night because we think it was given us from the right stand-point.

Mr. G. T. FLETCHER (Agent, Board of Education). I want to express my satisfaction, as a teacher, in listening to the address of Dr. Hodge. I think there never has been a time in our history when nature study was so important in our schools as it is to-day. As the speaker has said, the original communities in New England were farmers, and the boys and girls were in touch with nature. But there has been that neglect, that the speaker has so well brought out, with reference to encouraging children to raise plants to some purpose. I remember a time back when two boys in one of those homes felt that life was a drudgery, because they had to do a great deal of hard work; but one day some farmer said, "If you will raise a flock of chickens or a bed of beets, or some good product, they shall be yours," and thus those boys were stimulated to become intelligent, thrifty farmers. In our modern city life a large number of our children are removed in a large measure from touch with the soil; but still I feel there is hardly a boy or a girl who cannot have certainly a flower pot or a little patch of ground, either at home or in school, where something can be grown, and I have felt inclined to welcome most earnestly the introduction of nature study into our schools. But I have oftentimes been disappointed, sometimes discouraged and not infrequently disgusted, with the way the work has been conducted there through text books such as have been presented here to-night. The text book has its proper use and place, but it is first the study of nature, and then the books may give to the children some information valuable to them, and something they can understand. I am glad that our colleges and universities have come to realize and to present to the educators of the land the fact that there is something better than books,—and that is human life. We can remember in college in our early days how our education was pursued, and how little there was of natural science; but to-day the colleges and universities, with their experiment stations, are coming to give us more of the best results coming from the touch of the child with nature.

And now I want to state facts with reference to some of our schools here in Massachusetts, which may be a little more encouraging than some that the professor has so fairly presented. In one of these schools which I visited, the children have been gathering the various kinds of wood and giving a description of where they grew, and certainly many of them have found more kinds of wood on the hills of Hampshire and Berkshire than I supposed grew in New England. I visited a school where the children had brought the earliest flowers, telling where they grew, the soil in which they grew, etc. I was in a school to-day in this State in which the teacher had procured two specimens from the lobster family. You would have been interested in seeing how those children gathered around a little water tank, to see how these animals disported themselves and moved through the water. He told me that during the summer time he had had more than a dozen snakes of different kinds brought in by the children, and that they would pick them up and bring them in. And so the various forms of animal life and vegetable life are introduced in the schools, and the children are encouraged to watch the growth. I have seen in our country homes children that have tamed a fox, or a wild goose or duck; and I have watched with great interest to see what new interest there had come to be in the various forms of animal life. I think the children are going to come into closer touch in this way with our domestic animals, with a better knowledge, kindlier spirit, and disposition to treat them as they should be treated. I am very glad these strictures have come with regard to book study. The children should get their knowledge of nature through the teacher and from nature itself; and when our children can read the books of Mr. Burroughs we shall find that nature study will be much more interesting and very much more profitable to the children. Many of the teachers and many of the children do find, as proved to me in the State work, the study to be tiresome and laborious; but where the living things are introduced into the schoolroom, and the children brought into direct touch with them, they come to realize so much

more what nature means in the advancement of good citizenship.

MR. G. M. WHITAKER (of Boston). I have been very much interested in this address and the discussion following it, which will be an extremely valuable addition to the agricultural literature which the secretary of the Board of Agriculture advances from year to year. In my sphere of life I have given some attention to nature study in the schools. What I have done in the shape of reading in the work of the schools has been of a very superficial nature, but so far as my slight chance for observation has gone, I have not found anything quite so bad as those text books, and I want to ask the lecturer if there really is much teaching done in the schools of Massachusetts quite as bad as would be indicated by those books?

DR. HODGE. Massachusetts, I think, and I intended to speak of that, has the best system of leaflets; and that is a question that many of the agricultural citizens are taking up. These leaflets have all some meaning in them, not simply pretty studies to kill time, but to bring the children out knowing something about the insects, or the fungi, or the plants around their homes, and they bring them out with the idea of doing something. I have not found in Massachusetts much teaching as bad as those books, but I have found a great deal that comes pretty close to it. I go into a school and try to find out what they are doing with nature study; and if I had time I could give you several illustrations right in Massachusetts something like this: The teacher said, "Children, what is a hymenoptera insect?" And she had a picture of a honey bee on a black-board, — not a particle of honey or a bee or a wasp in the room, but a picture on the board of a bee. Well, the children mentioned over some hymenoptera insects, — a bee and a wasp and ants. "Into how many parts is the body of a hymenoptera insect divided?" "Three parts." "What is the name of those parts?" "Head, thorax and abdomen." "How many parts does the head contain?" "What are those parts?" "The head, the eyes and the antennae or feelers." "And what other parts?" None of the children knew.

“Oh, dear me! You must not forget that. And the tongue.” “Into how many parts is the thorax of the hymenoptera insect divided?” “Three parts.” “Three parts? How many parts is the thorax of the hymenoptera divided into?” “Three parts.” “Count them, please.” “One, two, three and four.” “Yes, children, the thorax of a hymenoptera insect is divided into four parts. Never forget that again, children. That is the most important fact for you to remember about the hymenoptera insect.”

Mr. E. H. FORBUSH (of Wareham). This matter of teaching natural science, or science study, in the schools was taken up by a score of us years ago and we did our best to get the study Dr. Hodge speaks of into the schools. The movement has been growing naturally now, and we are not getting nature study in the schools, we are getting text books, just as he has said, nothing but text books, and perfectly worthless text books, many of them. But again, this matter of teaching in the schools without text books results sometimes in something like this: my little girl was asked whether she could write a composition on the horse. I remember a little of it. “I believe that the horse has four legs, one on each corner;” and the end of the composition was like this: “The horse is better to ride than the cow.” That is about all the good you get out of that sort of teaching. One more subject which the doctor has touched upon interests me, and that is, the attempt to domesticate or utilize our native insect-eating birds. I am interested in that more than in anything else in the line on which the lecturer has talked this evening, and I think it is the duty of the Board of Agriculture to see that this work is done under its direction. It is in the line of the spirit of the age, and this Board is the body that should attend to it, and see that it is done. It seems to me we ought to find out how to attract these birds, how to keep them about our homes and how to utilize them, and it ought to be done now. While I was working for the gypsy moth committee I spent all my spare time upon something of that kind. The Board has asked me to write something, and I have chosen the way in which my children protect the birds about

our home, and what has come of it, and I hope that will be published and give a little light on the question.

Mr. J. G. AVERY (of Spencer). I have been much interested in the lecture this evening, and in one point particularly, — as to the incentive for children to do something to earn money for themselves. When I was a boy, I fell and injured my back so much that our family physician advised my parents to keep me very quiet. My father had a man to work for him on the farm, and his mother came to make him a visit. This was in Connecticut, and she came from Mansfield, a town where they raised silk worms at that time : and this lady, seeing my condition, said if I would hatch out some silk worm eggs, she thought I could do that well enough, and she would send me some. My parents talked the matter over, and said if I would like to do that, I might ; and if I could earn some money that way, it would be very pleasant to them and to myself. She sent me the silk worm eggs, and they gave me an attic in the ell part of the house, where I made the shelves of wood, where I could hatch these eggs and feed the worms. The trees from which I got the mulberry leaves were sometimes a mile or a mile and a half away. I went to see all the people who had mulberry trees on their farms, and asked permission to come and pick the leaves. I succeeded in hatching out those eggs and seeing the worms grow from little tiny things until they wound the cocoons, and then I had to go and get brush and put on the shelves for the spinning of the cocoons. It was an object lesson I never shall forget. I did all that work myself, and made ten pounds of raw silk. I took the cocoons and put them in a kettle or cauldron, and stirred them up and lifted them up to get the ends of the silk, and I wound it off myself, and made ten pounds of raw silk, which sold at five dollars a pound that year, — fifty dollars. I thought it was the most wonderful thing, and I was to have that money myself, and the fifty dollars was laid away for me, and did me a power of good.

Mr. JAMES DRAPER (of Worcester). I wish to say a word or two on the ownership of a tree or plant as a remedy for hoodlumism. I have to be a little personal in the mat-

ter, and state that a few years ago, like some others whose lives have been spent among the tree folk, I have been called upon to give short addresses before different associations, and newspaper men sometimes saw fit to publish a few of the things there stated, and they attracted the attention of the superintendent of schools of our city, and he met me and said, "Friend Draper, you have in your work brought out some ideas I would like to have brought before our teachers in the public schools." I said, "Very well. How shall it be done?" He said, "We shall have a meeting of our teachers before long, and I should be glad to have you meet them, and present to them your ideas of interesting the school children in this matter." I did so. I met the teachers, and I said to them that my heart was in the work of doing something for the embellishment of the school yard; that there was room for some trees and room around the edges for planting shrubs and small flower beds; and if we could interest the children in them, we should be directing them in a line I felt would be helpful. So I suggested to them how these children might all be interested in having a strip on one side for the boys and on the other for the girls, and little inner beds of earth, where each child should do something in the preparation of the soil, and also in bringing something for planting. And beyond that very few of the school yards had any shade trees in them; and I suggested that in a school yard where there were, perhaps, six or eight grades, that that year there be a planting of a class tree, of a grade tree, in the school yard, properly located, and that it be done with proper ceremony, and that day we would designate as Arbor day, in the spring, one for each grade, and we would have the tree purchased by the contribution of a penny from each of the children, so they would feel they owned the tree. Having arranged for that, let them so arrange their work as to dig the hole and plan for the securing of the loam, and then secure the tree; and at the proper time arrange for a little ceremony, some little recitation and reading about tree and plant life, and some singing, and then, at the proper time, arrange the classes to go around and each child

place over the roots a little shovel of earth, till the tree was planted: and in that way each child feels that he had something to do with planting that tree in that year, and that he had individual ownership in it. Well, now, that resulted in the planting of a good many trees and a good many shrubs in the school yards throughout the city.

There was a sequel to that, and it was this, that years later, as we were called upon under the direction of the Park Commission to plant shade trees in the city, near the edge of one of the parks we planted a few ornamental shrubs; and this year we have planted them in a section of the city where a few years ago you would say it was a waste of money, they would all be destroyed; and not a plant has been injured in that portion that would otherwise be called the hoodlum section. They have been taught to appreciate the plant and love it; and so I might say they respect the trees and the shrubs and the parks all over our city in a surprising degree, and if mischief is done, it does not come from the bad boy and those in the poorer sections, but from those who ought to know better when they steal the flowers from the more beautiful parks of our city.

The CHAIR. I want to express my gratification at the manner in which the doctor has handled this subject to-night. I confess I was not prepared for an address from a gentleman from a university that would accord with my opinions in regard to nature study to such a degree, but I am very happily disappointed. The doctor has given us a lot of common-sense and a good deal of instruction.

THIRD DAY.

The meeting was called together in city hall at 9.30 A. M., by First Vice-President Sessions.

The Chair read a telegram from the president of the Louisiana Purchase Exposition, extending hearty good will, and hope that Massachusetts may be adequately represented as regards her natural resources, when their gates are opened.

Secretary Stockwell read a telegram from Lieutenant-Governor Bates, to the effect that he would be unable to attend this session, as he had intended.

The secretary also presented the following vote of thanks which was unanimously adopted: —

That the thanks of this Board be extended to the Hampshire, Franklin and Hampden Agricultural Society for its invitation to the Board to meet in this beautiful city of the Connecticut valley, and for the many courtesies that have made our meeting here so delightful; and also to the delegate of this society for his personal work, — a service so promptly and efficiently rendered that to call upon him for service was perhaps too much a pleasure, the thanks of the Board are gratefully tendered for his efficient aid.

The Chair then called upon Second Vice-President Pratt of North Middleborough to preside at the morning session.

THE CHAIR. Connected with this Board is the farmers' institute work of the State, and all of us are aware how valuable that is. We are fortunate in having with us this morning a gentleman who has had much to do with this kind of work in New York State for many years. I understand he is a practical man, one who puts his thoughts into his work and I feel he knows thoroughly how to raise fruit. I take great pleasure in introducing to you Mr. George T. Powell, director of the School of Practical Agriculture and Horticulture, Briarcliff Manor, N. Y.

THE RELATION OF FRUIT CULTURE TO THE VALUE OF NEW ENGLAND FARMS.

BY DIRECTOR GEORGE T. POWELL, BRIARCLIFF MANOR, N. Y.

Prior to 1860 New England represented one of the strong and important sections of our country in agricultural production. Her soil is rough, but highly productive; her climate is rigorous, but she has produced many hardy and strong men, who have done much toward molding the character and destiny of our nation.

In 1864, when the Union Pacific Railroad Corporation was granted a charter to run its road across the continent, and in addition several thousand acres of rich virgin land, the New England farmer deserted his native hills for the more easily cultivated soil of the western prairies. But he left golden opportunities behind, in the development of finer and more valuable productions, to take up the cheaper kind of farming, — that of wheat growing. The history of the agriculture of the world is, that in the taking up of new land, the first operation on it is that of grain growing, because it gives the quickest return; but at the same time it is a long struggle before satisfactory profits and a comfortable living can be realized.

From 1864 began a most remarkable increase in the farms of our country. Our land was thrown open to the world, and the people from all nations were invited to come and take it without money and without price. From 1860 to 1870, 615,000 farms were added; from 1870 to 1880 the number added was 1,349,000.

Then we came to the day when agricultural products began to decline in value, followed by a condition of agricultural depression which spread over our whole country. This was due in part to the throwing open of immense tracts

of land for cultivation, for which there was not adequate demand, and in part also to the return from an inflated currency to that of a specie basis of payments. In no section was the effect of this decline in land values felt more than in our eastern States. Many farms in New England were abandoned, banks were left with farms of depreciated value to such extent that they could not recover their loans made upon them, and money began to seek other channels for investment.

During 1896, when our country was passing through its most depressing period, I made an investigation into the condition of the farming population of New York, and, while I found the conditions discouraging, I found instances where farmers were making six, and in some cases ten per cent on their investment in their farms. Now, these instances occurred where first-class dairy work was being carried on, and also where fruit culture was being intelligently followed: so that in the midst of the most depressing period in the history of this country there were still many farmers making as high as ten per cent on their investment in land. Here and there men were found who were making a careful study of their business, to meet the more difficult conditions, and they were making a satisfactory degree of success.

We are now in a new and more encouraging period in the agriculture of our country, and I want to give you just a few figures which are astonishing. We are entering a new era, as it were, in the history of our agriculture. Not only are our productions on an enormous scale at the present time, greater than ever before in our history, but we are receiving much better values for them. The farm products of the United States are worth about \$400,000,000 more than a year ago: the wheat crop is worth \$150,000,000 more this year than last: live stock is worth \$250,000,000 more than a year ago. Taking 1896 as a basis of values, nine staple crops are worth \$700,000,000 more than then. During the past five years our exports have been \$938,000,000 more in value than the preceding five years.

The world is realizing the fact that the United States are

capable not only of feeding their own people the best of any in the world, but also capable of feeding the world beside ; and here is the indication in these figures of the great demand that is coming to us from all over the world for the products of our soil. While these figures are almost beyond our full comprehension, the possibilities for improvement in quality along many lines, and of higher value received for better quality in everything, is beyond our most active imagination. With our vast area of agricultural land, our methods in farming have not only been crude, but most destructive in their effects. We have taken out crops for upwards of two centuries, and without reference to restoring the loss in plant food that results in long and continued production. When the soil has failed to yield profitably, as at the east, we have moved west, and on the rich virgin soil there continued our destructive process.

It was my privilege, only a week ago, to meet the Chamber of Commerce of Quincy, Ill., to discuss the question of land values at the west. While going over thousands and thousands of acres of the rich prairie soil of Illinois and the lower Missouri, inspecting many acres of orchards, I said that the time would be not far in the future when the west would again hear from New England. The same processes of destruction are going on at the west, I might say even more rapidly than they have proceeded here, because much of the west has not the advantages which we have here in the east in the deposits of rock which are continually renewing our soil, improving it, regardless of our destructive processes in production ; and I believe it is true that when the west shall have failed, — and the soil is failing rapidly, and much that used to produce thirty-five bushels of wheat to the acre, many, many acres to-day are not producing above eight or ten, — New England soil will be by no means exhausted. It is depleted somewhat, but nowhere near exhausted, and will never be ; so that the future, as I look upon the question of New England agriculture, is as promising as in any section of the country at the present time.

The first problem, then, in adding value to land, is to

maintain and improve its productivity. This is the first important step to take, whatever the line to follow, whether in general stock farming or in fruit culture.

APPLE CULTURE PROMISING.

One of the most promising industries for the future is that of apple culture, when we consider the subject of specialties in production. While there has been an enormous increase in the planting of apple orchards, yet the demand for this most excellent and standard fruit has kept fully apace with the supply.

We can realize something of the value of apples when we study the annual production of this fruit. The crop of 1901 is the smallest in many years, being but 23,075,000 barrels; in 1895 the crop was 60,000,000 barrels; in 1896, the largest crop ever produced, 69,070,000 barrels.

In 1898 I made an investigation into the value of the land in New York State for apple culture, and a report from twenty farms in Niagara County, covering a period of five years, showed an average income of \$88 per acre at the orchard. This was from the ordinary or little care that was given to orchards; and it makes the surprising income of six per cent on a valuation of \$1,466 per acre. Other reports showed \$110 to \$175 per acre income. One report gave the surprising income of \$700 per acre. This orchard was given the care, fertilizing, spraying and general good management that this fruit requires.

Now, this is a surprising statement to make, but when we count the income from the land, the same as we would from any other business, we find that such values as these are actually existing with us here to-day. The trouble is we do not place a high enough appreciation upon our land, we do not think sufficiently of the income which land is really giving us; but it is simply because we, as farmers and fruit growers, do not bring to our business the same kind of calculations, the same business care that other men have to do in their business, and hence we have not the knowledge, really, of the true facts in regard to the value of land. Now, if this value, taking the average of about

60,000,000 barrels a year, is considered as produced under conditions of the crudest kind of work, what are the possibilities in the future to those who enter apple culture upon the present improved modern methods that this splendid fruit really calls for in its production?

The value of New England soil and climate for fruit culture has not been fully understood. In portions of Connecticut, Massachusetts and New Hampshire the peach can be grown in its greatest perfection; the pear is produced at its best in a considerable section surrounding Boston; while the apple, the king of all fruits, can be grown with the finest of quality at most satisfactory profit in all the New England States.

New England, with her great manufacturing interests and large consuming population, furnishes a most extensive and valuable home market, while the port of Boston gives the most favorable rates and best facilities for foreign shipment of apples of any port in our country. While looking over the great orchard interests of the west, thousands upon thousands of barrels of apples come through to the port of Boston for shipment to foreign markets. If Kansas, Missouri and the west can send their apples across a large portion of this continent and put them in the English and foreign markets generally, why can't the New England farmer reap the benefit that is right at his own doors? I never was more impressed with the value of the ownership of New England soil than when in the western market I found those fruit growers shipping their fruits to the foreign markets through the port of Boston.

Another point is, that the climatic conditions and soil of these eastern States give the apple the highest quality in point of flavor, while the transportation facilities are ample and most favorable. With such conditions as these, the opportunity for development for a most valuable industry in apple culture on New England soil is particularly good.

Now, let us proceed at once to the question of methods. What are some of the most important requirements for success. First of all, the selection of good and suitable soil. The heavier loams are most desirable, and if some clay en-

ters into their composition, it is quite valuable for the keeping quality of the fruit. Avoid the sandy loams for apples, — they are better for peaches and cherries. Choose well-elevated positions for orchard sites, rather than low bottom land. These afford better natural drainage, while the circulation of air is also better, and there is less danger from frost when trees are in or just out of bloom. The cold air on frosty nights will roll down from the hills into the valleys, the same as water will seek the lower levels. There is also an advantage in the higher elevations from the fact that the winter temperature does not fall so low. The soil should be under cultivation to corn or potatoes one year previous to setting of the trees. This gives the best possible condition of soil before planting.

In the planting of the trees, give ample space. The mistake in our planting is crowding too many trees upon an acre of land; hence, give plenty of room. Now, what would be considered, here in New England, ample space? I should say at least from 40 to 45 feet distance each way. That is spreading out the trees a long distance apart; but right here is another suggestion, — that you do double planting. When you start an orchard, double plant this same piece of land, — that is, set in the spaces between the rows with early bearing kinds that mature early; and you will see that for a number of years the fruit can be made in this way to add largely to the profits in the business. Then, when the trees begin to crowd upon each other, take out the inside trees. Now, I feel that I must be a little careful in recommending this practice, for the reason that there are very few men who plant trees this way who have backbone enough to take them out when they ought to; hence I want to give a word of direct caution at this point, because the man who plants this way and does not take out his trees at the right time will ruin his whole business, because his land will be so filled with the roots of these trees that one will overlap the other, and there will be so much shade cast upon his orchard that his fruit will not be of good quality; and if he thinks, “I will take just one more crop,” and then one more, and just one more, he

will find the whole scheme will be a failure. While I do recommend this system of double planting, I want emphatically to say to every man that he must ruthlessly take out these extra trees. That leaves his permanent orchard with the trees a distance of 40 to 45 feet apart, and they will stand for time to come: orchards properly planted here in New England, and cared for, are good for at least one century. There is value in this system of double planting, provided the trees are taken out at the right time: for the first few years of bearing will pay the entire cost, and leave a profit at the time trees as ordinarily planted will begin to give profits.

Another very important point in this matter is the selection of the trees. There is no more important phase of this work than the proper selection of trees for planting an orchard. I want to say right here that our methods in apple culture have been as crude as in other work: hence to-day the man who plants trees should plant trees from the standpoint of proper selection.

TREE BREEDING.

A few words upon the question of breeding trees. No farmer here to-day would think of raising stock upon his farm without first giving the most careful attention to its breeding. He intends that it shall have good qualities, which shall be transmitted to the herd he is going to build up. This principle is equally true and valuable as applied to trees. We have not given this thought of breeding to trees, we have not thought of breeding trees as we have horses and cattle: but there is as much value in the idea as in breeding a cow or a horse. We have to spend a little time upon this point, because I believe we do not comprehend to-day, we do not fully understand, the real value of starting trees upon the same principle that we would start a good horse, — from the principle of selection from the best.

How can this be done? I have spoken of the improvement and of the high quality which it is necessary to get in the apple, and that we have in New England and the east

the conditions to put into the apple the finest quality of any section of our country. The King I will mention as an apple of high quality, and yet I should not recommend any one to plant it, because it is a tree that is constitutionally weak, will not live beyond twelve or fifteen years, and is especially affected by canker and other diseases, it would be ill advice to any one to plant it: and yet there is no apple that sells in the English market, except the Newtown Pippin, that brings so high a value as the Tompkins County King. It has been my desire to grow the King, and I am growing it to-day, because of its value, its fine quality. The great demand for it has put me in the channel of working, studying and thinking along the line of tree breeding, and how I should arrive at the method.

A number of years ago, I had more time to prune trees than I have to-day, a work that I always enjoyed; and nothing would please me more than to spend two or three hours every day of my life pruning trees. Unfortunately, I cannot get the time to get to the apple trees as I would like to; but when I had more hours to spend in the orchard I made this discovery, — that when I pruned trees such as Greenings and Baldwins, it was comparatively easy work, but when it came to the Spy, it was entirely different. I found I could get tired in two hours, and if I pruned Northern Spies all day, I was considerably tired. What is the difference? The wood of the Northern Spy tree is tough, of fine grain, and hard, and when you saw the wood it is like sawing through steel. Realizing this difference in the wood, while sawing upon the hard wood of the Spy, the thought came to me, what would be the effect of transferring King buds or scions to the Spy stock; and the longer I sawed the harder I thought on the subject, and I resolved to plant a King orchard in this way. From the nursery I selected one hundred trees of Northern Spies. The thought arose if there is to be any value in this change of method of propagation, I must look to the character of the trees from which I take King scions; and I could not take one from the trees on my own farm, for every tree was weakened by disease, and I felt certain if I took the scions

from my own trees I would simply be transmitting the weaknesses I already had. I sent to Tompkins County, where the King thrives at its best, and had scions selected from the best trees, free from disease, trees that gave the best quality of fruit, and that bore annually instead of once in two or three years. I received scions from trees of this character, and transferred them to my Northern Spy stock.

Now, what is the process? First purchase good, strong, thrifty, two-year-old Spy trees, planting these, and then letting them stand one year. After they have stood one year, then scions were set in a portion of the tree first. The King scions were set in the Northern Spy stock. Now, the question is, why not top work the whole tree at one time? Some have done that, and made a mistake; if you cut off too much foliage the opportunity for the tree to draw plant food the scions require is impaired. You must leave some foliage to the tree to supply food, and the next year finish grafting.

At the present time I have taken an entirely different course, using buds instead of scions, and thus saving time. In July or August, as soon as the bark works properly, we take the buds, inserting them in the place of the scions. The practice among nursery men very largely has been in propagation to take the buds at the nursery from young trees. The principle is not a correct one, because on all the young growing trees the buds that are there are buds that are producing growth of the tree. You have no fruitfulness in the buds. I am reversing that practice, and taking the buds from trees that have maturity, that are producing fruit; and the buds taken from such trees are inserted, and it reduces the time of getting an orchard into bearing at least one-half. Upon the King trees I have had apples coming right along four years from the time the scions were set. Now, in the budding process I am having the fruit at three years, and here [showing] are apples taken from buds set only two years. This new method eliminates this long period of time which we usually have had to wait for the production of the fruit in planting apple orchards; so the method of propagation coming from the selection of

the buds, as I have indicated, is one that promises to give most satisfactory results.

Now, I believe there can be still further improvement in this matter. There are nurseries in New York State that have been working upon this line of the propagation of nursery stock from buds from mature trees. A few weeks ago it was my privilege to go through several nurseries in New York State, and one in particular where propagating the stock from bearing tree buds was carried on to a large extent in the nursery. I saw in this nursery trees standing about four and a half to five feet in height, with fruit buds upon them. I never saw before a body of trees that had the appearance of business in them that those did, showing this nursery man has the right idea in the propagation of trees; and in his nursery to-day, at two years of age, are trees that will bear apples next year. That is a great improvement in the matter of propagating trees, and I believe that, by selection, we are going to gain advantage in the purchase of trees thus grown, and save time and expense in top-working the trees after we get them.

At this point let me say that the nursery man that propagates trees like this should get a higher value for them, because he misses a great many more buds. The buds from young and growing trees grow easily. Take them from the mature trees, and there are many more misses in the nursery. I would prefer to pay a dollar apiece for trees so taken, than to receive others as a gift. That is my estimate of the value of trees thus started. The nursery man has the right to receive more for such trees, as it is more costly for him to grow them.

It is a question in my mind still whether they are shorter lived, with the right method of culture. I think they need not be necessarily shorter lived, but if they are we get our profits in a shorter time.

NEW VARIETIES.

Another important line of work that gives promise of value is the origination of varieties adapted to the conditions where the fruit is to be grown. We have orchards

full of disease, bearing fruit of inferior quality, because varieties are planted that are not suited to the soil and other conditions where they are grown. Through seedlings and hybridization there are great possibilities of getting new and most valuable varieties that are better suited to different and widely varying sections, where orchards are being planted on a large and commercial scale.

A word in regard to new varieties. We are continually looking for new varieties of apples. Some of them are good, but my general advice is to hold fast to that which we know is good, — prove all things, hold fast that which is good: we find our present varieties are many of them most excellent and desirable. Yet there is a field of interesting work open in this direction, especially for young men and women. I want to include young women, for I have known a number equally interested in these matters, and who have given as intelligent study to them as men. There is no field to-day that gives such promise of value as the origination of new varieties that may bring us something a little better than we have, perhaps a little better adapted to our conditions. Many are making the mistake of introducing new varieties of which they know nothing, originating, perhaps, in the south, which may be good there, but have no value here. There is here an undeveloped field in the production of new varieties that would be adapted to the conditions surrounding each place where it shall be produced. This is a line of the study of horticulture, which I believe has great possibilities in it.

Passing from that point, let us take up the question of the management of the soil. Trees having been selected and grown upon this improved method, the management after planting becomes highly important. In a large majority of instances, clean cultivation of the soil will prove better. To the want of cultivation, more than any other cause, may be traced the great amount of inferior fruit that is found in our markets. In a recent trip across the country I could count the orchards under high cultivation upon the fingers of one hand, from New York to the Mississippi River. The orchards are usually left to take care

of themselves. They are in the sod, they are left to the attacks of insects and fungous diseases. The wonder is we have any orchard at all, from the condition we find all over the country. In most uncultivated orchards seldom above 20 per cent of strictly fine No. 1 apples can be barreled: 60 per cent will run No. 2, while 20 per cent will be unmarketable. Where cultivation is given, it should be done by plowing very lightly at the earliest opportunity in the spring, and then keep the ground frequently harrowed up to July 10 or 15.

I will give you, as briefly as possible, my own method of handling an orchard. I am a believer in high tillage. The cultivation practically is this. Begin as early as possible in the spring, stir the ground, plow the land lightly. We do not practise deep culture, but surface culture, for two purposes, — the conservation of moisture and elimination of the plant food that is in the soil.

There is going to come before Congress at this present session a great demand for enormous sums of public money for public irrigation in the west. It is a question whether general taxation is wise to provide water for the arid acres of the west. I believe it is possible for us at the east, and very much of the west, to so pursue a system of cultivation that we can dispense with public irrigation. I know we can do it here at the east, and the processes are proper tillage, and also the conservation of moisture by the introduction of cover crops to our orchard lands. Cultivation is given, frequently stirring the soil, and as a result, by this process we can conserve to a large extent the moisture that is in our soil. Take, for instance, the section of soil about our trees. [Blackboard.] What is the action of the water in the soil? Why, there is a constant effort to the surface. In the spring, as hot weather approaches there comes greater pressure and effort on the part of the water to come to the surface and pass off by evaporation. If we properly till the soil and keep the surface in the finest possible condition, we conserve and hold the moisture that under a crude system of cultivation will pass off most rapidly by evaporation. The roots of trees will obtain more water, provided we hold it

at this point. Hence I believe it is possible in New England to grow crops of apples, or peaches or plums, or any tree fruits, through the severest drought, and without their materially suffering, by this process of holding the moisture where trees can utilize it, instead of having it pass off so largely by evaporation. When we have given this high tillage, we must protect the soil, or plant food set free by tillage will be lost during the balance of the season. Here comes in the importance of clover crops.

I have used with success crimson clover for this purpose. Crimson clover is an annual plant, and for this reason it grows quickly and will make a better cover than the common red clover when sown as late as the middle of July. Where crimson clover will not thrive, Canada peas will do well and will be of value. The renovation or improvement of the soil through the use of clover or peas may be obtained most economically. I believe it is possible to continue and to increase the production of the soil for generations to come, and by the aid of the clover and other leguminous plants to add more nitrogen than will be taken from the soil by the crop grown. The following analysis was made of the soil in one of my pear orchards after three crops of crimson clover had been grown and plowed in, the orchard producing at the same time three successive crops of pears without other fertilizer being applied. Three years prior to this clover culture there had been a heavy application of manure made from grain fed steers. One sample of the soil was taken six inches deep, in the orchard, and one from the same kind of soil, near by and adjoining, where no clover had been grown for three years. The analysis is as follows:—

| | Three Crops of Clover (Per Cent). | No Clover (Per Cent). |
|--|---|--------------------------|
| Water, | 15.00 | 8.75 |
| Nitrogen, | .21 | .12 |
| Humus, | 2.94 | 1.91 |
| Phosphoric acid (available), | .015 | .008 |

Difference in water, 6.25 per cent makes over 46 tons per acre ; difference in nitrogen, .09 per cent makes 1,350 pounds more per acre ; difference in phosphoric acid, .007 per cent makes 105 pounds more per acre. It would have cost, to purchase 1,350 pounds of nitrogen, at 15 cents per pound, \$202.50 per acre, yet the clover seed for three years cost but \$3 per acre. The seed was sown when the cultivation of the orchard ceased, about July 5 to 10, and was lightly covered with a smoothing harrow.

I think there is a limit to the extent to which it is wise to use clover or peas as a cover crop, as too much nitrogen will affect the keeping quality and the color of the fruit, the effect being to prolong the maturity of the fruit, and cause red apples to take on a lighter color. After a few years of the use of these cover crops, rye can be substituted in their place.

I firmly believe that, by an intelligent use of these cover crops, New England and all long-cultivated soil may not only be economically restored and improved, but that greater production can be obtained than ever in its history.

The crimson clover makes a large growth of fibrous roots ; these, together with considerable top plowed in, make a large amount of humus, which is highly necessary to the moisture-holding capacity of the soil. During the year this soil was analyzed, the samples were taken during a very prolonged drouth. A full crop of pears was carried through which obtained no damage from dry weather. Three years of added humus had been of great value in holding and giving off gradually the water that had been absorbed during the winter and spring months.

It took three dollars' worth of seed for three years, and yet, for that outlay, there was this gain in the amount of nitrogen. Fruit growers and farmers, I believe it will not long be necessary for you to stand indebted to a heavy bill for nitrogen. Let me recommend you to take up this system of culture, and if you find after a few years that crimson clover does not thrive upon your New England soil, take the Canada peas and you can get this benefit.

A striking illustration of soil improvement may be taken

from the farm upon which the new School of Practical Agriculture and Horticulture has been located at Briarcliff Manor, N. Y. A peach orchard was planted in May, 1900, in the poorest land upon the farm. I was informed by the "oldest inhabitants" that nothing could be grown upon that land with any profit whatever. The trees were set and cut back to 18 inches in height; the most thorough tillage was given up to the middle of July; 3 pounds of nitrate of soda, ground bone and muriate of potash, in equal parts, were applied per tree, at time of setting. At the last cultivation of the trees, 12 pounds of crimson clover were sown and covered lightly. The trees made a very strong growth, and the same year developed fruit buds. The second year, thirteen months from the time the trees were set, they bore from 50 to 139 peaches. The most of this fruit was taken off and not allowed to mature. There are thousands of acres of poor land in many sections of our country that could be made highly productive and valuable when given the right treatment.

There has been a very steady decline in the condition of apple orchards and in the quality of fruit, and this in the face of an increasing demand for good apples in both our home and foreign markets. This arises from two causes, — the first from the general neglect and want of better care of our old standard varieties of apples, and the second from the want of greater effort to produce new varieties better suited to present conditions. There is need of the production of more apples of finer quality. What is it in an apple that gives the most satisfaction in its use? It is first of all high flavor, juiciness, fine grain and tender flesh. If these qualities can be accompanied by beautiful and attractive color, it adds always to the value of the variety; but attractive color and appearance alone will not always satisfy the consumer. For a time a handsome apple will go first and most readily; but if appearance is its only good quality, when the fact is learned there will be less satisfaction in using this fruit, the fact will be recognized that the fruit does not taste so well as it used to, and there will follow a less consumption and demand for this most desirable fruit.

This raises the question, especially in the west, of the future value of the extension of the Ben Davis orchards. This apple has made a wonderful record, and it has undoubtedly made a great amount of money for those who have planted it at the south-west. While this has been true up to this time, it does not follow that it will always do so. The Ben Davis has two valuable qualities that have made it popular with the growers and handlers, — its fine color and its good handling and keeping qualities; but it is thick skinned, tough fleshed and void of any particular flavor. The more this type of apple is put upon the market, the less will be its consumption, for the consumers who want high flavor in the fruit they use will turn to bananas, oranges and other fruits. This is not an apple for New England.

Upon this point, in speaking of the value of the "American Apple Consumers League," the proprietor of one of New York's best restaurants says: "I have been in the restaurant business over twenty-five years, and never, strange as it may seem, sold an apple on my tables till about two years ago. A friend of mine, a clergyman, said to me at that time: 'Why can't I get some apple sauce here?' I told the steward to buy a barrel of apples, and I have never been without them since, and I made my friend a member of the Baked Apple and Apple Sauce Association. I have great difficulty in buying the kind of apples I want. Except the Long Island Newtown Pippins, which we have great difficulty in getting, the Spitzenburg, I think, is the best for baking; the Rhode Island Greening the best for cooking and apple sauce. I think packing in boxes is a very great improvement on barrels, and, while the cost is a little more, the waste is less. For my table I must have quality and uniformity. I can afford to pay a good price, for I get 15 cents for two baked apples and a pitcher of cream, and my customers pay it willingly, in competition with a Ben Davis at 10 cents for two big apples. When people do make a comparison, I simply tell them that I pay \$7 a barrel, and can buy Ben Davis for \$3. Of course up to this time it has not become a very large part of the business, but it certainly is increasing. I think we use for baking and eating

raw about a barrel a week, and for sauce and stewing another barrel. I expect this winter to use more. I am using now for eating apples what is called the Spitz, for which I am paying 15 cents a dozen. Go ahead, brother; give us a good flavored apple, uniform in size and convenient package, and you will have done more for posterity than many men with their millions."

Here is a clear indication of the tastes and demands of the consumer, which it will be wise for the producer to recognize. The question of varieties must be left to each section to determine; and there is a most valuable field open to young men to begin systematic work in hybridizing and producing new seedlings that may give some new and very desirable kinds, combining most of the excellent qualities desired. Sutton Beauty, Rhode Island Greening, Baldwin, Mackintosh Red, Pound Sweet, are among the best apples for New England, and for these there will always be a great demand.

While the subject of spraying has been very fully discussed, its importance is comparatively little understood. One of the first objects in spraying is to secure in the tree the greatest vigor and thrift, and this can be obtained only from a healthy and perfect foliage. The fungicide is of equal if not of greater value than the insecticide. Upon the condition of the foliage of trees depends the keeping and all good qualities in the fruit. This is of utmost importance in our export trade. Much of the loss that comes from shrinkage, known as slacks, wet and wasty, is with apples that have been grown upon trees that have had defective foliage caused by fungous attacks and injured by insects. Fruit from such trees will have poor flavor, poor color and poor shipping and keeping qualities. Spraying, then, should be most thoroughly done, and materials should be properly made, and trees sprayed regularly every year. It is a mistake not to spray trees in off years, or when they are not bearing much fruit. The spraying should begin from the time the trees are set, for during the years of early growth they are equally subject to fungous and insect attack, and are much weakened by the time they begin to

bear fruit. If these methods are thoroughly practised, there is no way in which suitable soil can be employed that will give more satisfactory returns than in apple culture.

The income from land devoted to apple growing on these principles is practically unknown, and money so invested has a certainty of return in per cent of interest that can only be measured by the skill, the intelligence and the application of good business methods that may back it.

There is no more promising field for young men to enter than the developing of New England soil for the culture of apples of fine quality. I can say with much satisfaction that one of the most promising students in the new School of Practical Agriculture and Horticulture, recently established at Briarcliff Manor, N. Y., is one of your Boston sons, of typical New England stock, endowed with energy, intelligence and determination to succeed in his efforts to enter upon the new agriculture for New England. Other students taking this course in agriculture are contemplating purchasing land at the east, because of the excellent markets that are so near, and the low prices for which land can be bought. In addition to this young man who is preparing in this most thorough manner to enter this higher field of agricultural work and life, there is an instance of one of your most prominent and successful business men, a leading manufacturer of Massachusetts, taking up land for the purpose of reviving and reinstating agriculture in New England upon the better lines of development that are certain to bring better results to those who will adopt the advanced methods that are called for to meet present conditions. I look upon this as a most significant movement on the part of one of your most prominent men, a gentleman who has reached the three score and ten period, to take up agriculture with all of the interest and energy of a man of fifty, and bring to it the careful, thorough business methods that he has brought to manufacturing for forty years. He has taken up land and is putting out apple orchards, and proposes to follow closely the methods laid down in this discussion as an object lesson of value to the young men of the east, and to those who will bring to this work the same

study and good business practice that he is inaugurating; they will find both pleasure and profit in following his example.

The day of cheap land is rapidly passing, and when finer fruit is produced, better horses, better cattle, better wheat and other productions of a higher grade, all of which call for better and stronger men to develop, the value of land will be better understood and it will be more actively sought after, as present tendencies clearly indicate.

QUESTION. When would you turn in the crimson clover to get the largest amount of plant food from it?

MR. POWELL. Always as early in the spring as possible. I get the autumn growth. Between the 1st and 5th of July cultivation ceases in my orchards. This season has been favorable to a good growth of crimson clover, and I have it six to eight inches in height, and it thoroughly covers the ground for the winter. I want no growth in the spring. Why? for every day the plant grows, it is pumping up the water, and that I don't want, so I plow it as quickly as the soil will admit.

QUESTION. Why not plow it in the fall?

MR. POWELL. I want this cover for the soil. I don't want to plow it up and leave it to the action of the winter.

QUESTION. What do you do about mice?

MR. POWELL. Mice do not come to that kind of ground. You find mice in old meadows, but not in new, fresh, growing clover. We have no trouble whatever from mice.

QUESTION. Would there be any advantage in using seeds of the Northern Spy for propagation?

MR. POWELL. I am not able to judge of that point, but I don't know that there would be any particular advantage in using Northern Spy seeds, because most seeds will produce a good tree. I think it would be of value upon the line of breeding to follow on the line of the Spy seed. The French stocks are considered better than the American stocks, because they are stronger and more vigorous.

QUESTION. Is the Jonathan a long keeper?

MR. POWELL. Yes; it will keep on my farm up and into

the month of April. I am along the Hudson, where apples ripen twenty days in advance of those in Massachusetts.

QUESTION. Would apple trees be likely to thrive and do well on plain land? We have in the valley, lying back from the meadows, a sandy loam, — quite sandy.

MR. POWELL. That soil is better adapted to peaches, cherries and some kinds of plums. Apples need a soil that is what might be termed heavy loam, and if there should be in it some clay that would be better.

QUESTION. Is the Jonathan apple a good bearing one, — equal to the Baldwin?

MR. POWELL. Yes, Baldwins will yield more barrels but sell for lower price. There is an apple here in New England that is not well known and is of very superior quality, and that is the Sutton Beauty. I have three hundred trees of this variety on my farm.

QUESTION. Is it a good keeper?

MR. POWELL. An excellent keeper, and it can be taken out of storage and used early, or it can be kept late. It is good early, and equally good late.

QUESTION. Does it make a good cooking apple?

MR. POWELL. The very finest, and as a table apple at least fifty per cent better than the Baldwin, — a beautiful apple in appearance, equally attractive as the Baldwin, and very prolific. It will stand against the apple scab, when the Baldwin will go down.

QUESTION. Will you give us your method of trimming peach trees?

MR. POWELL. Every branch is taken off the tree when it is set. Cut off all the side branches, prune quite closely, then head down to about eighteen inches, and let the top come out at about this point [showing]. The second year keep the trees pruned open, let the sunshine down through all parts of the trees, give the trees free circulation; in a year like the present, when we have wet weather, a tree not kept open with a free circulation of air will suffer very much. In the intervening years that follow, take out a great deal of inside wood. Cut back branches, at least one-third of all the growth annually after they begin to bear.

QUESTION. At what season?

MR. POWELL. In the spring, after the hardest freezing weather is past, when you can determine the character of the wood, whether it has been frozen or not, to some extent. Then you can see and can detect all appearance of injury to the wood.

PROFESSOR FERNALD. I would like to ask whether the San José scale is a menace on the fruit? I am receiving complaints from fruit growers in Massachusetts that in some cases they are unable to market apples, pears and other fruits, because of the presence of the scale on their fruits.

MR. POWELL. Yes, it is. There are two pests that it seems to me are a menace to fruit growing in the northern part of New York and New England. In New York State there is nothing we dread so much as the possibility of the gypsy moth getting away from you and coming over there. The national government should have come to the aid of Massachusetts long ago in exterminating the gypsy moth. In regard to the San José scale, that is equally a menace with the gypsy moth. It is being disseminated all over the country. We have some in New York nurseries, I am sorry to say. We have a system by which the nurseries are inspected. An agent of the Department of Agriculture goes through the nurseries to discover the scale. Many are fumigating nursery stock with hydrocyanic acid gas, and that is certainly a great precaution; I believe that fumigation is going to give us greater safety than any system of inspection. Suppose an agent goes through and inspects a nursery; he may not discover the scale, or there may possibly be scale produced there after his inspection; and if one pair gets into the nursery, by the end of the season they will have propagated something like three billion. Inspection is by no means a certain way to protect the nursery stock, and, while fumigation is an expense upon the nursery man, I believe it is the safe thing to do to have his stock thoroughly and carefully fumigated before it is sent out.

Now, what about the farmers who have it on their places?

That is a source as dangerous as to have it in the nursery. Some orchards are filled with San José scale. I believe that if the scale gets into an orchard, you can only keep it in control. So we have to study and work along lines of control, keeping it in check, using a system of inspection and fumigation. It does not injure the sale of the fruit.

QUESTION. Did your experience of budding the King apple or Northern Spy stock prove successful?

MR. POWELL. In nine years of growing the King upon the Spy stock there has never been the first evidence of disease. The particular disease of the King is the apple canker. I feel quite certain to-day that my King orchard is going to be good for fifty years to come, at least. This has been a very bad year for apples. Those trees grafted nine years ago gave from a barrel to a barrel and a half apiece, which are worth to-day in the New York market not less than \$6 a barrel, and \$9 or \$10 in Europe.

QUESTION. What is the nature of apple canker?

MR. POWELL. A fungous disease that attacks the branches, first dark-colored patches or spots, as big, perhaps, as a five-cent piece, and increases until it becomes as large as a half-dollar. Then you see patches of it working up and down the branches of the trees. In a short time the bark is destroyed, and the tree declines and dies. I feel that the Spy stock is helping the King. It is so vigorous that it has more resistance against the disease.

QUESTION. Is it best to keep on raising the Ben Davis apple?

MR. POWELL. The tendency is, in New York and New England, to plant the Ben Davis apple. Don't plant it in New England. You can grow so much better apples, apples that have better quality. The Rhode Island Greening is much better, and will give you as many barrels as the Ben Davis. The market is asking for the Rhode Island Greening. Don't plant the Ben Davis when apples of higher quality can be so easily grown.

THE CHAIR. I have the pleasure to state to the Board that President H. H. Goodell will preside during the remainder of the session.

DR. GOODELL. My friends, we have listened this morning to a discussion of the relations of a single one of our industries to one section of our country, the New England States. We are now coming to the discussion of a theme very much wider, which is the relation of a people, our colored citizens, not to a single industry, but to all productive industries; not to a single section, but to our whole country. I have the pleasure of introducing Dr. Booker T. Washington, the principal of the Tuskegee Normal and Industrial Institute.

THE COLORED RACE AND ITS RELATION TO THE PRODUCTIVE INDUSTRIES OF THIS COUNTRY.

BY DR. BOOKER T. WASHINGTON, PRINCIPAL TUSKEGEE NORMAL AND
INDUSTRIAL INSTITUTE, TUSKEGEE, ALA.

I very much fear that I shall do what we sometimes term in the south "Following the old white cow." Gentlemen engaged in agriculture will understand, I think, what that means. During the days of slavery a master rode out into his field early one morning to show his servant John what to do during the day, and he pointed across the field to an old white cow, and said to him, "John, plow straight to that old white cow, and you will have a good basis or starting point for your plow during the day," and with that comment the master rode off out of the field about his other affairs, and did not return to the field until about four o'clock in the afternoon. When he returned he found that John had been following that old white cow through the field all day. Well now, in the south, where a cow gets a nibble of grass about once in every two or three yards, you can imagine something the condition of that field when the master returned. This morning I very much fear you will find me following the old white cow a good deal.

I am not fitted by experience or by education to be your instructor this morning along any line. I was born a slave on a plantation in the State of Virginia, about the year 1858 or 1859. I have never been able to learn the exact date or even the place of my birth, but I am pretty sure I was born somewhere at some time.

After I had gotten to be a free boy, and had gone into the State of West Virginia and spent some time working in the coal mines, in some way, I hardly recall now, I found my way to Hampton Institute in Virginia, an agricultural

institution, and I shall never forget the first experience I had in attempting to enter that institution. I had been without proper clothing, without proper bathing, without food, for so long a time that when I presented myself to the teacher in charge of that agricultural school I did not present a very encouraging specimen: and the teacher began to look me over, — looked at my head, looked at my face, looked at my clothing; then she began to look at my feet. That was the last place I wanted her to look, because every toe that I had was out of the shoes that I had on. I kept trying to hide my feet behind the desk, and the more I tried to hide them the more closely she looked at them. I seemed to be all feet that morning. But after a while I got her to the point where she said to me, “You take this broom and sweep the next recitation room.” Well, I took that broom and I swept that room over three times, and then I got hold of a dusting cloth, and I dusted that room four times. After I was through with the dusting, this woman, who was in charge, who happened to be one of these New England Yankees who knew just where to find dirt every time, took a handkerchief and came in and put it on the benches and tables, and she could not find an iota of dust in that whole room. She said, “I think you will do to enter this institution.” That was the college examination that I passed.

I remained in Hampton for four years, working my way through that institution. While I was there I said if God would permit me to finish the course of training there, I would go into the far south and I would give my life in whatever humble manner I could, trying to teach my people there the lessons of industry, of thrift, of economy, that were taught to me at Hampton.

In 1881 I went to the black belt of Alabama, and started, in a little shanty, with one teacher and thirty students, what is now known as the Tuskegee Normal and Industrial Institute. This shanty in which I began to teach was in such a condition that, during the first weeks I taught in it, whenever it was rainy one of the largest students would very kindly cease his lessons and hold an umbrella over me

so I could go on with the recitations. After I had used the shanty a few weeks, and the number of students began to increase, I found it necessary to call into use an old-fashioned henhouse. I mention this because of its relation to the subject of productive industry, especially to the branch of agriculture. I found it necessary to call into use an old-fashioned henhouse, and I said to an old colored man one afternoon that I wanted him to come the next morning and help me clean that henhouse out, that we had to use it for school purposes; and the old fellow with considerable excitement said to me: "What yo mean, Boss? You sholy are fixing to get right into trouble. You're sholy a stranger round here, you think of cleaning out that henhouse in the daytime."

That was our beginning at Tuskegee in 1881. As I analyzed the life of the people of my race in that section, soon after going there, it seemed to me there were a few primary needs to which we should give our attention, especially if we would lift them up, or, what is better than that, get them to the point where they would lift themselves up. In analyzing their condition, we found that in a very large degree they were without proper food; that they needed to be taught the lesson of raising, in an intelligent way, the food upon which they were to subsist from day to day. We found them in a very large degree without shelter, without homes. We said: "These are the cardinal needs of the people, — food, shelter, clothing; and it seems to us the part of common sense, the part we should perform in uplifting them, to teach them, through the medium of men and women whom we shall send out from this institution, to supply these primary needs as fast and as soon as possible." So we said that as far as possible, while giving our students education in the book, we were going to teach them, while they were in the school, how to earn their living intelligently and successfully out of the soil upon which they lived. We felt that, if we were to help those people, we must go down to the foundations of their life.

Some time ago, in the south, in the teaching of a Sunday-school class, an old minister was trying to explain to

his class why it was and how it was that the children of Israel were able to cross through the water without getting drowned, and why it was that when Pharaoh and his party came along they were rather unfortunate and got into the water. The old minister said: "T'was this way: when the first party came along it was early in the morning, and cold, and the ice was hard and thick, and they had no trouble in crossing over dry-shod on the ice. But when the next party came along it was twelve o'clock in the day, and the sun had been shining hot on the ice, and it had melted, and it broke, and they went in and got drowned." He had in his class a young man who had been going to school a good deal, and he said: "Mr. Minister, I don't understand that kind of explanation. I have been going to school and I have been studying all these kind of things, and my geography teaches me that ice doesn't freeze within a certain distance of the equator." The old minister said: "I have been expecting something just like that. There is always some fools always ready to spoil all the theology. The time I was talking about was before they had any geographies or equator either." That old minister in his humble manner was simply trying to brush aside all the artificiality, and get down to bed-rock or common sense. That is what we have got to do in our efforts to lift the people up at the south.

In the beginning of our work at Tuskegee we found these people needed to know how to make their living intelligently and skilfully out of the soil upon which they were living. They needed to be taught how to get hold of decent shelter, of homes, and how to clothe themselves. Then we said: "If this is a school, we believe that the school should not only be a place where an individual can learn to study about things through the medium of books, but we believe that in a large degree it should be a place where people can study not only about things, but actually study the things themselves." And we said, further, that "We believe that this institution can be a place where people can not only study things, but actually learn to do things."

We believed that where we were dealing with a race, and in the case of my race we must remember that before it was brought into this country it had no necessity to labor. After it was brought here, for two hundred and fifty years my race was forced to labor under circumstances that were calculated to do anything but give that race a love for the beauty, the dignity, the civilizing power there is in labor of the hand. So we said: "We are going to teach our students to cultivate the soil, and raise, as far as possible, the food that we are going to consume."

In this institution, beginning in a humble way, we have gone on developing the industry of agriculture. At that institution at the present time our young men cultivate every year something over seven hundred acres of land with their own hands, and not only cultivate that land in a way to make it bring in a return to our department, but in a small degree they are making the farm an object lesson for the students and the people in that section of the country. We try to teach our students something of the chemistry of the soil, the best and latest methods of dairying, care of the stock, care of tools, and numbers of other lessons important for any people where we may remember that eighty-five per cent of the population is living by some form of agriculture. These students are not only taught these agricultural lessons at Tuskegee, but, what is better, what is most encouraging, as I hope to show later, they not only get hold of these lessons, but they go out into the various districts of the south and use those lessons in the betterment and uplifting of their fellowmen.

Then we said: "Since at this institution we are without buildings, we are going to teach the students how to erect their own buildings, and give them this practical training in the building of homes; so that when they are through with their education they can go out into the various districts of the south and build their own homes, and teach the people by whom they are surrounded also to build their homes." Some people said we could not do that; that it was not a practical thing to teach our students to make the

bricks and to put up their own buildings while they were getting their education. You know there are some people who always object to everything. They object to everything that has not actually been done for three thousand years. If a thing has been done, going on in the same way three or four thousand years, they won't object to that; but no matter how much common sense it has in it, no matter how much it applies to the direct condition and needs of the people by whom one is surrounded, if it wasn't done in the same way thousands of years ago, there are some people who object to it. Some people said: "You can't make bricks by the labor of these students, and have them build their houses, and educate them at the same time."

In the south there is a Baptist church that had a deacon that would always object to everything. They wanted to buy a new table for the church; he objected right away. They wanted to increase the pastor's salary; the deacon always objected to that. They wanted to buy some new hymn books for the Sunday-school; he objected right away to that. They wanted to repair the church; he objected right away, — and the church couldn't make any progress, and it was a great puzzle with the other deacons what to do. Finally, after pondering over the matter at considerable length of time, they decided to call a special meeting. It was called, and they decided to have a special prayer-meeting, at which they should pray for some way by which to get rid of old Deacon Siah's objection. One of the deacons was appointed to make a special prayer, and he got down there and fervently prayed that the Lord might purify old Uncle Siah, and that he might sanctify Brother Siah, and finally that he might sweep him through the pearly gates and "Take him home to thy bosom in heaven." "No," Uncle Siah says, "I object to that." There are some people who object to everything that hasn't been in existence for two or three thousand years.

Now, I confess that in the teaching of this lesson of house building to our young men we had a pretty hard time at first. In some way we got a brick yard started,

and we had not only to teach them to make bricks, but to educate them so they would not only build our own buildings, but go out and scatter that lesson in every section of the south. We got in some way about twenty-five thousand bricks, — pretty bad-looking bricks, I confess, — made by the labor of these students; and in some way we got them built into a kiln and the kiln about half up, and when it was about half done, by reason of some defect it fell. People said: “I told you so. You can’t do it.” I said: “We are going to try again.” We pitched in and got about forty thousand bricks made the next time, and got the kiln nearly completed so far as the building was concerned, and there was some defect, and that fell. People said: “I told you so.” I said: “We are going to try again.” Then we got a third kiln to the point where it was nearly half burned, and that fell. People said: “I told you so.” Still I said: “We are going to try again.” At that time we did not have any money. I have heard about making bricks without straw, but I will tell you, my friends, something harder than making bricks without straw, and that is, making bricks without money. You give me the money, and I will get the straw and make the bricks some kind of way. I had no money, but I did have a watch which a friend had kindly given me. I got on the train and went to Montgomery, Ala., a place forty miles distant, and sold the watch to a pawnbroker, and when I returned I had nine dollars; and I put this nine dollars into making the fourth brick kiln, and that time we succeeded; and we have made bricks from that time until the present, and the past season our students manufactured with their own hands a million and a half of as good bricks as I believe you have in the State of Massachusetts. What is better than that, we send out into every section of the south dozens of men every year who go out with a knowledge and skill which enables them to become first-class brickmakers in nearly every State in the south.

We must remember, my friends, as I have said, that eighty-five per cent of our people in the south live by agriculture in some form. Since that is true, it seems to

me the part of common sense that in a very large degree, especially during the next fifty or one hundred years, we ought largely to centre our education in that direction. Education, in my mind, whether of black people or white people, increases and cultivates wants. A boy coming from the plantation district of the south to Tuskegee, from one of the cotton plantations, perhaps, before he comes to us has never worn a collar or necktie, and has not had any cuffs, to say nothing of cuff buttons. If he wanted a walking stick, he went to a hickory tree and cut himself a stick, and was satisfied with that. That boy comes to school a few years, rubs up against a different civilization. Very soon, naturally and rightly, he wants a collar, he wants a necktie, he wants cuffs, he wants a walking stick that is painted, — perhaps one that will cost seventy-five cents or a dollar, that is bought from a store, instead of being gotten from an old hickory tree. He returns to his home, and he wants, rightly, to put carpets on the floor and pictures upon the walls. That man's education has increased, multiplied many times his wants.

Now, my friends, I claim that a system of education, — especially when applied to a people whose condition is that of the mass of my people in the black belt of the south, — any education that in a very large degree increases their wants without at the same time increasing their ability to supply those increased wants along lines at which they can find immediate employment, is rather a mistake. Wherever this is done you will find in many cases people yielding to temptations, and not answering the purpose for which their education was intended. We find that through the teaching of these industries at these various agricultural and industrial institutions at the south we have gained immensely in the spirit of self-reliance and spirit of self-confidence which has given to them certain mental and moral backbone; and these are lessons which are most needed wherever these educated men and women go to settle among our people in the rural districts of the south. When the Bible says, "Work out your salvation with fear and trembling," I am almost tempted, my friends, to believe that the Bible means

about what it says ; and I believe it is very largely possible for a race, as for an individual, to actually work out its salvation ; and in the south, in a large degree, we are to work out our salvation in the farm, in the shop, in the school, in the college, with the drill, with the hammer, with the saw, with the plow, — in a large degree we are to work out our salvation.

At one time in Georgia an old man wanted a turkey for Christmas, and every night he prayed, “ Lord, please send dis darkey a turkey,” but none came ; “ Lord, please send dis darkey a turkey,” but none came. One night the old fellow got down on his knees and prayed, “ Lord, please send dis darkey to a turkey,” and he got one that same night. Now, I do not know how Massachusetts farmers get their turkeys ; but there is not very much we get as individuals, whether we are black people or white people, unless we put forth some kind of an effort for it, like that old black man down in Georgia.

Slavery was a great curse in this country, — a curse upon my race, a curse upon your race ; but, in the providence of God, when it comes to the matter of production, I believe that God permitted us to get two blessings out of the curse of slavery. I am not apologizing for that institution. For two hundred and fifty years, through the medium of slavery, God made the southern white man come into business contact with the negro. When the white man wanted a house built, he went to a negro mechanic to consult him about the plan of the house ; he went to a negro mechanic to construct the house ; he went to the negro shoemaker for his shoes ; he went to the negro tailor for his clothing. Not only that, but for two hundred and fifty years every large slave plantation was, in a limited sense, an industrial school. On those plantations a large number of our people were taught farming, wheelwrighting, carpentering and brick masonry. It paid in the days of slavery to make mechanics of the black people. A common black man on the auction block would bring about seven hundred dollars ; a mechanic would bring from twelve to fourteen hundred dollars ; and at the same time when you could get as much as

seven hundred dollars for a common black man, why, you couldn't get as much as fifty cents for the best white man in this room. You see we have always had an advantage of your race, and we want to keep it as far as possible.

Now, I am speaking seriously, that this business contact and this training placed us, our class that worked in the south, in the position of the skilled laborer in that section. But for twenty years, in methods of education, our people, except General Armstrong, that rare man at Hampton, forgot what had been taking place on the plantations for two hundred and fifty years. Our people were educated by the book and in the matter of religion; but then the fathers who had learned to be skilled laborers and mechanics during the years of slavery began to depart by death, and then we began to awake to the fact that we were not educating up black boys suited to take their places. Then from all over the country, from England and from the north, there began to come into the south in a flood skilled hands and educated brains; and we found they were gradually taking from us the legacy of our skilled labor purchased by our forefathers at the price of two hundred and fifty years of slavery. The only way the negro can establish his industrial basis in the south, and the foundation upon which, gradually, many of these troubles and problems will be solved, is this, — not only in our education to turn out men and women educated in head and heart, but to send out every year a stream of men and women whose hands are educated as well as their heads; and certainly, in order that the negro may become what the country wants him to become, he has got to learn to do three things, — to put brains and skill and dignity into the common occupations that are about his doors. He has got to learn to do a common thing in an uncommon manner. He has got to learn to do a thing so well, no matter how common that thing may seem, — he has got to learn, whether it is in agriculture or mechanics or domestic service, he has got to learn to do that thing so well that nobody else can improve upon what the negro has done. And I may add here that it seems to me that the whole future of my race hinges itself upon the question whether we can get him to

such a point that the people of the community where the race lives will feel that they cannot dispense with the presence and the service of that race ; and, my friends, when you have taught any man, black or white, to do a thing better than somebody else, you have solved the problem so far as that individual is concerned, and the same is true of races.

Now, with a people in a state that the masses of my people are in, I sometimes have the feeling that mere book education, without that training which will make them love the labor of the hands, which will make them see in that labor natural dignity, beauty, and I am almost tempted to say Christianity, — without that I am afraid we shall be in danger of producing smart men. From one of the men working at Tuskegee I heard of a young colored man in an adjoining town who had the reputation of being extremely smart, and I had a craving to come in contact with that individual. One day that occasion presented itself, and being in that town I inquired about this man, and they pointed him out to me and said : “There he is now, standing on the street.” I said : “What is he doing?” They said : “Nothing just now.” I said : “Perhaps he has a farm in the country?” “Oh, no, he hasn’t any farm in the country.” I said : “Perhaps he is a carpenter.” “No, no ; he isn’t a carpenter.” Well, I said : “Perhaps he is an architect.” “Oh, no ; he isn’t an architect.” Then I said : “Perhaps he runs a steam laundry.” “No, he doesn’t run a steam laundry.” “Well,” I said, “What does he do?” “Why, nothing. He is just smart, only smart, just a smart man, just smart.”

I had a friend some years ago who lived in the State of Kentucky, and this man and his wife had by a great deal of expense and sacrifice sent their only boy through the public schools of that State, and at more expense and sacrifice sent him finally to college ; and in due time this young man returned to his Kentucky home with his college diploma in his hand. But the old father, who was a man with no book education, but a great deal of horse sense, watched his boy after he came home from college ; and he remembered that before John went to college he used to work on the farm,

and he used to do errands, and he used to bring into the family treasury a considerable sum of money in one way and another. After John came home from college the father noticed that John kept talking about his good days in college, but he did not suggest going back to the farm, and he walked about the streets and called upon the neighbors; and finally this young man came to the old fellow and asked him to lend him fifty cents to buy a new-fashioned necktie which had just made its appearance. The old fellow scratched his head. When the colored people down south want to think, they scratch their heads. He remembered that before John went to college he didn't wear any necktie at all, and he wondered what the advantage to him was now of this fifty-cent necktie; but he let the son have the necktie, and the thing went on until finally the young man came to the father and looked him in the face and asked him to lend him four dollars to buy a pair of patent leather shoes. The old man scratched his head harder than ever before, but he let him have the four dollars, and the thing went on. Finally there happened to appear in this town a man from one of the New England towns, and this old man watched the visitor from New England until he caught him around the corner where none would observe them and said: "Mister, I want you to help me. I's in trouble sho enough. I's in deep trouble, and I want you to help me. My son John has been to school, my son John has been to college, my son has got good education, he has got his head full of that thing; but, Mister, for God's sake I want you to help me. My John has got his head full of that thing, but Mister, for the Lord's sake, take John and tell him what to do with that thing he has got in his head." Well, very largely as a race I find more and more the question forcing itself upon us is, how to teach our people to use that thing they have got in their heads. There is not much difficulty in getting it in there, but to get the power to use it. Well, the visitor from New England called upon this young man by appointment, and he had a good, plain, common-sense conversation with him. He said to him: "Mister Jones, when you were in college didn't you study chemistry?" "Yes," he said; "I spent

a long time in the study of chemistry.” “Why don’t you take your knowledge of chemistry and go out and use it on your father’s farm?” The young man said: “I hadn’t thought of that; I hadn’t thought of chemistry being good for use on the farm.” “When you were in college, didn’t you study mathematics?” The young man said: “Yes; I spent years in the study of mathematics.” “Why don’t you take your mathematics and go out and use it in showing your father how to lay out his land better for corn raising?” John said: “I can do that; I hadn’t thought of mathematics being good for laying out corn rows.” “Didn’t you study botany when you were in college?” “Yes; I studied botany when I was in college.” “Why don’t you take your botany and go out and show your father how to improve the plant growth on the farm?” The young man said: “I can do that;” and with this suggestion and advice this young man went on to the old farm and put into it the full force and power of his mathematics and his science; and to-day I can take you into the State of Kentucky and show you one of the most prosperous farms to be found in that State, all as the result of this young man being taught to use the thing that he has got in his head. So at Tuskegee our problem is not only to put the thing into the head of the young man, but to teach him that the thing in his head is worthless except as he uses that thing in making the world better, more useful and more happy. We try to teach our students that an educated man standing on the corners of the streets with his hands in his pockets is not worth one whit more to society than the ignorant man standing on the streets with his hands in his pockets.

Now, it is not our idea to teach the negro to become a producer in any line of industry by the old method that was employed in slavery, but to teach them upon our farms and in our twenty-seven other industries to labor up out of drudgery and toil into an atmosphere where labor becomes beautiful and productive. I confess, my friends, that if I had to feel that I had to become a farmer in the south and to follow an old blind mule through the fields the remainder of my life, I should not have much enthusiasm about be-

coming a farmer. Some years ago I happened to be in the State of Iowa, and I saw a man at work planting corn, and all the work he seemed to do was to sit on some kind of a machine and hold back two fine-spirited horses to keep them from working themselves to death. This white man was not only sitting on the machine, but he had a big red umbrella hoisted over him. I had never seen a man planting corn that way before, and I became immensely interested in it, and I noticed that the machine that the man was sitting on went over the ground and plowed it, and I think it marked the furrows, and I am very sure it dropped the corn into the furrows and then it covered the corn. After a while I was in Georgia, and I saw a black man planting corn, in fact, I saw him competing with the white man in the State of Iowa in the corn markets. He had a plow and an old mule, and he had a pole about five yards long hitched to the old plow. The mule would go a few yards and stop, and this fellow would reach back and get the pole and lam the old mule. The old mule would prick up his ears and go on a little faster. Then the poor fellow had to stop again and knock the old plow together, to keep it from falling to pieces. The plow was about three inches wide, cutting about three inches into the land. After he got the plow fixed he would go on a little further, and then have to stop to tie up the harness to keep it from falling to pieces. It was made partly of rags and partly of leather. He would get the harness fixed and go on until he got nearly to the end of the row, and then he had to stop again and fix up his one gallus to keep his pants intact. He was one of these one-gallus farmers. I don't suppose you have any of them in Massachusetts. This one-gallus farmer would go over that land with that old mule plow and plow it up. Another one-gallus farmer came behind and marked out the furrows. A third one-gallus farmer came behind him and dropped the corn into the furrows, and another one-gallus farmer came and covered the corn. My friends, under any conceivable circumstances, is it possible for that black man in Georgia, following that old mule, to compete with that man in Iowa sitting down under that red umbrella? There

is a good deal of prejudice in this country, north and south, but I will tell you something there is very little prejudice in, and that is the American dollar. You are going to buy your corn every time from the individual who can produce it and sell it the cheapest, whether that man is white, brown, blue or green in color. It doesn't matter about the color of his skin, when you buy corn. You buy the cheapest and best corn. The importance, then, in an industrial education, is helping to get the negro boy through the south to use care and skill until he can sit under a red umbrella and raise corn just like a white man does, and I do believe in that kind of thing. In a word, my friends, in the south the problem, in a large degree, is to give the young man so much love for agricultural life, showing them how to lift it up out of drudgery and out of toil, until a man will feel, after he gets his education, that he must return to his father's farm, and not yield to the temptation to go to the city and try to live by his wits instead of living by honest, productive toil. We find that in proportion as we can teach our young men to put brain and dignity into an agricultural life and into all its avenues, they do return to the farm and do teach their mothers and fathers, by reason of their brain and skill, how to raise upon an acre of land fifty bushels of corn where only twenty-five bushels were growing before.

Some time ago in a northern city I found a white man washing shirts. I do not know as you have ever seen a white man washing shirts. I have. As usual, this white man was sitting down. The white man doesn't do much work unless he does sit down, but he gets there, nevertheless. When the world wants corn or cotton, it doesn't care whether it is made by a negro standing up or a white man sitting down. All it wants is the best product. This man was washing shirts sitting down. Once in a while he would touch a button and start a machine to work, and it seems to me he was washing shirts at the rate of fifty an hour. This man was sitting down, and half the time he was reading a newspaper. One of those things that will wash fifty shirts an hour and let a white man sit down at the same time

is going to be moved into Georgia, Alabama and Mississippi, after a while. When that is so, how long are our women going to hold on to the industry of washing by the old process? Not long. We have to teach our people to put skill and training and dignity into the common occupations about their doors. In proportion as we teach them those lessons, in the same proportion we find them getting upon their feet, helping themselves, and, what is better than that, getting to the point where they make themselves such an important part of the community that the people will feel that wherever there is a negro, there is a man adding something to the really higher and better life of that community.

The negro in the south, works, as a race, and especially is that true in the rural districts. You will find a greater proportion of idleness in the cities and towns. In the agricultural districts, in his way, the negro works; but by reason of his ignorance, his lack of experience, his lack of skill, in too many cases he does everything in the most costly and most shiftless manner. Do you know, my friends, that in the south the average negro farmer in the cotton belt has to mortgage his crop every year for the food upon which to live; that he pays, on an average, for the food which he gets in that manner, interest that will range from twenty to forty, and even in some cases fifty per cent; that the average negro farmer lives in a one-room log cabin, upon rented land, and that he has to rent the mule that he uses. How are we going to change that condition of things? My friends, we are changing it gradually, not all at once, but surely that kind of thing is being changed. At Tuskegee, at Hampton, at other institutions in the south, we are educating young men in the industrial and agricultural ideas, sending them out into the rural districts to teach the people how to save the money that is spent for whiskey, snuff and cheap jewelry, and teaching them to buy land and build decent and comfortable homes; and gradually we are getting them to the point where they are giving attention to the education of their children, and where they are beginning to become intelligent, reliable citizens of the communities where they reside.

Last September I met one of these men, a type of those to whom I have referred, and I said to him: "Uncle Jake, where are you going?" He said: "Ise gwine to camp meeting, Mr. Washington." I said: "Do you really think you are able to go to camp meeting and spend your time there singing and shouting?" He said: "Yes, Mr. Washington, I am going to camp meeting this year, sure. I haven't been for eight years, but I am going this year, sure. Eight years ago I went to the Tuskegee Conference of Farmers, and you told the people to buy land." Every year in February there assembles at Tuskegee eight hundred to a thousand farmers, representing the people of their sections in the south, and we talk over all the problems that relate to their industrial, educational, moral and religious life, and this man had attended one of those conventions. He said: "Mr. Washington, I haven't been to camp meeting for eight years. Eight years ago I went to the Tuskegee Farmers' Conference, and I heard you tell the people to buy land, and I heard you tell the people to save their money and build decent homes and educate their children. Mr. Washington, I have been trying to follow your advice, and I haven't been to camp meeting for eight years, but I am going this year. I have bought fifty acres of land, and I have paid the last dollar on this land, and I am going to camp meeting this year, Mr. Washington. I've done build a house on the land, too, and the house has got four rooms to it. It's no one-room log cabin, it's got four rooms, and it's painted inside and outside, and I done paid the last cent on the house, and I sure got a right to go to camp meeting this year. Do you see this wagon we's riding in? This is Jake's wagon. When we were made free I bought a buggy; but I found a negro farmer has got to ride in a wagon before he can ride in a buggy, so I sold the buggy and got a wagon. Do you see that wagon we's a riding in? That is no white man's wagon, no white man has a mortgage on that wagon. That's Jake's wagon. Ise done paid the last dime on that wagon, and that wagon has got a right to go to camp meeting, too. Do you see those black mules that's drawing that wagon? Those are Jake's mules. Those are no mortgaged mules. I paid the last dime on

those mules, and those mules got a right to go to camp meeting, too. Do you see those gals sitting in Jake's wagon? Those are Jake's gals, and they have got a good education. Do you see the dresses those gals have got on? I bought the cloth for them, but the gals made all the dresses themselves, and they got a right to go to camp meeting, too. Do you see that basket in that wagon? There's corn bread and meat in that basket, and its no store-bought bread and meat; that is good home-made bread and meat. I raised the pigs, and the old woman cooked the meat; and I raised the corn, and the old woman cooked the bread: and we's all going to camp meeting together to shout and have a big time, because we has money in our pockets and religion in our hearts."

Now that is the type of man we are raising up in every part of the south: and more and more this country must learn to judge us by that type of man,—judge us by the best the race can produce, and not by the worst the race produces; by those that are educated in the home or in the school room, and not by those in the gutter and the penitentiary. Do you know, my friends, we have gotten to the point where in the State of Virginia the colored people own one-twenty-sixth of the land in that State. We have gotten to that point where in the Blue Ridge Mountains the people own one-sixteenth of the real estate, in Middlesex County one-twelfth, in another county one-tenth, and in another county one-sixth. Do you know that in the State of Georgia, the people, starting with poverty, with nothing but their bodies, thirty-seven years ago,—do you know that in the State of Georgia this year the black people are paying the taxes upon fifteen million dollars' worth of property: and the negro has learned a lesson down there, too, which the white man has taught him,—not to give in his property at its full taxable value; so that I expect, if we could stand right straight up and be counted, we would be paying taxes upon perhaps twenty-five or thirty million dollars' worth of property in the State of Georgia. Now, that is but one example, and I believe these figures are taken from the books in the State capitol

of Georgia ; and if we could get at the actual fact, I believe that they would teach us that the colored people in the other southern States are making progress just as manfully as that. These census figures show that the colored people number more than four hundred thousand heads of negro families in this country. Do you know that we have already paid for and are paying taxes in this country upon two hundred and sixty-four thousand farms, — two hundred and sixty-four thousand of us own farms and are paying taxes upon those farms. That is pretty good, my friends, for a race that started in absolute poverty a few years ago.

The problem that confronts us with the negro is not only to get him to the point where he can make his own living, where he is sure of three good meals a day, but we have the added problem confronting the white man in the south to-day in the education of the race. I speak of getting the race to the point ; I lay a good deal of stress upon the industrial side of our life, not because I believe that is the end of life, not because I believe that is the highest thing, the thing after which we should most strive, but because I realize thoroughly that farming and plowing and industry of every kind is not an end, but a means towards reaching those high mental and spiritual things which we all consider the real life.

But in the south we find, much as I suppose you find it here, it is a pretty hard thing down there to make a good Christian of a hungry man. I find a hungry farmer is a dangerous farmer in the south. I was talking to an old colored man some time ago who lived in a community where ten years ago they used to have hogs stolen every week ; somebody was always in the courts of Alabama for hog stealing ; and I met one of the men from this township in the road some few weeks ago and I said : “ Uncle Sam, I haven’t heard anything of hog stealing from your township for several years. What has taken place ? ” He said, “ Mr. Washington, we’s all got hogs.” Nobody felt the advantage of hog stealing. It makes a great difference whether we are out of hogs or not, whether we favor hog stealing. You can’t make a good Christian

down there out of a hungry man. I have tried it a good many times. As long as a fellow is hungry, I don't count much on his Christianity.

As a race we are rather emotional. You can beat us at thinking, but the average colored man will feel as much in ten minutes as the average white man in an hour. We feel our religion in the south, as you do not. When the negro gets converted, he wants to get up and jump around a little, and manifest his feeling visibly; and if he doesn't do it, we get kind of skeptical about his religion, and say he has the white man's religion. Our emotional side of life gets us into awkward positions. Not long ago, in the south, an old colored woman went to an Episcopal church one Sunday morning, and they gave her a seat in the gallery. As the good rector began to get worked up to a considerable degree of eloquence, the old colored woman began to feel good, happy, and she commenced to clap her hands and groan a little, and say amen. One of the officers of the church came to her, and he said: "My good woman, what is the matter with you? What are you making all this noise about?" She said: "Why, I am happy; I've got religion." "Got religion," he said; "Why, this is no place to get religion."

Now, seriously, my friends, this emotional side of our life tempts us to spend a great deal of time getting ready for life in the next world, and overlooking the things of this world. In Louisiana, on one of those sugar plantations, they have an old song which they sing at revivals, — "Give me Jesus, give me Jesus, and you take all this world." Well, the white man down there takes the negro at his word every time. I do not speak irreverently, but after eating and sleeping with my people, coming into contact with them by night and by day during nearly twenty years, I think I have learned that the way to teach them to have the most of Jesus, and have Him in their daily lives, is to teach them to mix in houses and farms and banks, just as a white man does, — mix the practical, every-day affairs of life in with their religion; and in proportion as we teach them those lessons, we can point you to whole communities that are on their

feet, owning the land, educating their children, living strong, helpful, American lives. We have not only got to get our own people on their feet, but to convert the southern white man to the point where he can see that an educated, scholarly, conscientious black man is of more value to society than an ignorant, worthless black man. Gradually we are doing that.

I remember some months ago I met a southern white man on the street, who said to me, "Washington, I hear you are educating nigger dairymen over to Tuskegee. I want a dairyman. I want you to send me one." I picked out one of the most intelligent, scholarly, conscientious men that had ever graduated from our dairy school, and sent him to this southern white man. About six months after, I met this same white man and he said to me: "Mr. Washington," — he didn't say "Washington" that time, — "Mr. Smith," — he didn't say "nigger dairyman," either, — he said: "Mr. Smith has revolutionized my dairy business. He has cleaned up the whole establishment, he has systematized it, and for the first time in its history it is upon a paying and satisfactory basis." He said: "Mr. Washington, I want you to send me another graduate just like Mr. Smith."

Now, my friends, no amount of abuse, no amount of quarrelling or fighting, could have made that southern white man respect me and that institution. We have got to go on gradually, quietly and persistently, eternally putting before them these object lessons, showing them, by evidence indisputable, that an educated negro is of more value to the south than an ignorant negro.

Some years ago one of our men began to try to see how many bushels of sweet potatoes he could produce on a single acre of land. After a number of years he got to the point some time ago where he could produce two hundred and sixty-six bushels upon one acre. The average in that community had been only forty-nine. When this black man produced two hundred and sixty-six, you ought to have seen the white farmers come to see how he had done it. They forgot about the color: they didn't have a bit of prejudice

against those sweet potatoes. They knew there was a black man who, by reason of his knowledge of the chemistry of the soil and improved methods of agriculture, had added something to the wealth, the usefulness and happiness of the community in which he lived. The putting of one negro like that, my friends, persistently into a community, will in the end produce the result of solving what we now term this race problem.

My friends, may I add this, not immediately upon my subject, — but remember, no matter what life you lead here, that we have before our country in the south perhaps the most tremendous and serious problem that is confronting the country, — a problem which will not be solved until it is solved in justice and righteousness to all parties concerned. My friends, remember that you have a part of the responsibility in this matter. This is not alone the negro's problem, this is not alone the south's problem; it is the nation's problem, because the nation was responsible in a large degree for its creation. Probably no member of your race, whether in Massachusetts or in Georgia, can harm the weakest or meanest member of my race without the bluest blood in your civilization being degraded. Remember, as we come up, your race comes up; as we go down, your race goes down. We are bound together: we cannot separate ourselves one from the other, if we would.

THE CHAIR. It is customary, after every lecture, to have a discussion. You have heard to-day some truths, and home truths, that you may like to discuss. The discussion is thrown open to any one in the hall. If any one would like to ask Dr. Washington any questions, we have still a few moments at our disposal.

QUESTION. How many scholars do you have in your school?

DR. WASHINGTON. We have about twelve hundred.

QUESTION. What are their ages?

DR. WASHINGTON. We do not admit any under fourteen. Their average age, I should say, was eighteen and a half. A few are about forty years old, but not very many.

Mr. POWELL. With reference to your teachers, have you had difficulty in getting teachers who were thoroughly qualified and competent to give the peculiar instruction which your students need?

Dr. WASHINGTON. Yes; that has been one of the most difficult things with us, — to get teachers who understand the practical part of the subject, and then at the same time have the ability to teach it in the best way. We are gradually overcoming that difficulty, but it has been a tremendous one.

QUESTION. Are your teachers all colored?

Dr. WASHINGTON. All colored; yes.

QUESTION. Do you receive considerable aid from the American Missionary Association?

Dr. WASHINGTON. Something, but a very small portion of our expenses come from that association.

Dr. LEARNED. Would you advise a continuation of the same quality of education there as you have to-day fifty years hence, provided the colored population were the owners of the entire real estate there, and provided, also, they have the bank deposit that will average along with the white population of the northern States, — would you continue the same practical line of education?

Dr. WASHINGTON. I think the education should suit the actual condition of the people. As the condition changes, I think the education should change. I have spoken a good deal of the industrial side of education. I do not mean to limit education to that side; but to the man who comes to the point where he owns his farm and has a bank account, it will be but a short way into the near future when he gives his daughter or his son a purely literary or college education.

The CHAIR. This concludes the exercises of this meeting of the Board.

ANNUAL MEETING
OF THE
BOARD OF AGRICULTURE,
AT
BOSTON.

JANUARY 7 AND 8, 1902.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 7, 1902, at 11.15 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by Second Vice-President AUGUSTUS PRATT.

Present: Messrs. Anderson, F. H. Appleton, J. S. Appleton, Avery, Barrus, Barton, Benedict, Boise, Bowditch, Bradway, Brewster, Bursley, Carpenter, Clark, Comins, Danforth, Ellsworth, Gleason, Goodell, Goodspeed, Hersey, Jewett, Kilbourn, Lyman, Pratt, Reed, Richardson, Sargent, Sessions, Spooner, Stockwell, Thayer, Thurston, Turner, Wellington and Whiting.

The executive committee, as committee on credentials, by Mr. W. A. Kilbourn, chairman, reported the list of qualified members of the Board for 1902. The newly-elected members are as follows:—

At large, appointed by the Governor:—

William R. Sessions of Springfield.

Elected by the Societies:—

Deerfield Valley, Arthur A. Smith of Colrain.

Essex, John M. Danforth of Lynnfield.

Highland, C. K. Brewster of Worthington.

Hillside, J. W. Gurney of Cummington.

Middlesex South, Isaac Damon of Wayland.

Plymouth County, Augustus Pratt of North Middleborough.

Worcester, J. Lewis Ellsworth of Worcester.

Worcester County West, J. Harding Allen of Barre.

The report of the committee was accepted and adopted.

First Vice-President SESSIONS, coming in, took the chair.

On motion of Mr. Avery it was

Voted, That a special committee be appointed to take into consideration the matter of societies charging admission fees for entry of cattle at fairs, the matter of societies increasing the amounts offered as premiums for cattle, and the advisability of asking the Legislature to permit this Board to offer premiums in such manner as shall further promote the breeding of live stock within the limits of this State.

The Chair appointed Messrs. F. H. Appleton, Avery and Anderson as the committee. Later the committee reported as follows : —

Whenever, in the judgment of the government of societies receiving bounty from the State, it is deemed practicable to charge entrance fees for neat stock, this Board commends doing so. While, in the judgment of this special committee, the interest of the breeding, within the State, of higher grades of live stock would seem to demand the offering by the State of attractive prizes of high value, they do not now see the practical way to advise for doing so, but commend the idea to the careful consideration of the Board.

The report of the committee was accepted.

An abstract of the annual report of the secretary was presented, read and accepted.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted and ordered printed.

The committee on gypsy moth, insects and birds, by Mr. Pratt, chairman, presented a written report, which was accepted and ordered printed.

The report of the Dairy Bureau was read by the general agent, Mr. Whitaker, and was accepted.

Voted, That the Bristol County Agricultural Society be heard at 2 o'clock P.M. on the matter of the violation of the

rules of the Board in holding its 1901 fair on other days than those assigned it by the Board, and that at 2.30 o'clock p.m. the Franklin County Agricultural Society be heard on its request for the Board's approval of its vote to mortgage its real estate.

At 1 o'clock the Board adjourned to 2 p.m.

The Board was called to order at 2 p.m.

The special assignments being in order, the matter of the Bristol County Agricultural Society was taken up and considered, and the matter was discussed by the officers and representatives of the society and by members of the Board. The Board then went into executive session, and after remarks by several members it was

Voted, unanimously, that the request of the Bristol County Agricultural Society for the assignment of certain days in the last week in September for its fair be not granted.

Voted, unanimously, that the Board of Agriculture, having heard the Bristol County Agricultural Society in regard to its violation of the regulations of the Board in the matter of holding its 1901 fair, is of the opinion that the said society is not entitled to bounty from the State.

Voted, on recommendation of the committee on credentials, that the credential of Mr. William A. Lane as delegate to the Board from the Bristol County Agricultural Society be not accepted.

The request of the Franklin County Agricultural Society for the approval by the Board of Agriculture of its vote, passed at its annual meeting, held Dec. 21, 1901, "That a committee of three be appointed, to act with the president and treasurer, to execute a note or notes secured by a mortgage or mortgages, to raise money to pay part or all of the outstanding obligations of the Franklin County Agricultural Society, including the indebtedness to the Exhibition Hall Company, with the approval of the State Board of Agriculture," being in order, the matter was heard.

It appearing that the law had been fully complied with, and no person appearing in opposition, it was

Voted, To approve the above-quoted vote of the Franklin County Agricultural Society, to an amount not exceeding seven thousand dollars, in accordance with the provisions of chapter 124 of the Revised Laws.

The executive session being dissolved, the committee on Agricultural College and education, by Mr. Barton, presented a written report, which was accepted and adopted as the report of the Board to the Legislature.

The committee on forestry, roads and roadside improvements, by General Appleton, chairman, presented a written report, which was accepted and ordered printed.

Voted, That when the Board adjourns it be to 9.30 o'clock to-morrow morning.

An abstract of the reports of inspectors of the several fairs, prepared by direction of the committee on agricultural societies, was read by the secretary.

Voted, To accept the reports of inspectors.

At 5.07 the Board adjourned to 9.30 A.M., Wednesday.

SECOND DAY.

The Board was called to order by First Vice-President SESSIONS, at 9.45 A.M.

Present : Messrs. Allen, Anderson, F. H. Appleton, J. S. Appleton, Avery, Barrus, Barton, Benedict, Boise, Bowditch, Bradway, Brewster, Bursley, Carpenter, Clark, Comins, Damon, Danforth, Ellsworth, Goodspeed, Hersey, Jewett, Kilbourn, Lyman, Pratt, Reed, Richardson, Sargent, Sessions, Smith, Spooner, Stockwell, Thayer, Turner, Wellington and Whiting.

The records of the first day were read and approved.

The committee on domestic animals and sanitation, by Mr. Damon, chairman, presented a written report, which was accepted and ordered printed.

The committee on experiments and station work, by Mr. Hersey, chairman, presented a written report, which was accepted and ordered printed.

The committee on institutes and public meetings, by Mr. Sargent, chairman, presented a written report, which was accepted and ordered printed.

The report of the librarian was read and accepted.

Election of officers being in order, the chairman declared His Excellency W. MURRAY CRANE president of the Board (by a by-law of the Board the Governor is *ex officio* president).

Further elections by ballot resulted as follows : —

First vice-president, Hon. WILLIAM R. SESSIONS of Springfield.
Second vice-president, AUGUSTUS PRATT of North Middleborough.
Secretary, Hon. J. W. STOCKWELL of Sutton.

General agent of the Dairy Bureau, GEO. M. WHITAKER of Boston.

Election of specialists being in order, ballots were taken, and the elections resulted as follows :—

Chemist, Dr. C. A. GOESSMANN of Amherst (Massachusetts Agricultural College).

Entomologist, Prof. C. H. FERNALD of Amherst (Massachusetts Agricultural College).

Botanist and pomologist, Prof. S. T. MAYNARD of Amherst (Massachusetts Agricultural College).

Veterinarian, Prof. JAMES B. PAIGE of Amherst (Massachusetts Agricultural College).

Engineer, WM. WHEELER of Concord.

Ornithologist, E. H. FORBUSH of Wareham.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees) :—

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, Isaac Damon of Wayland, John Bursley of West Barnstable, Wm. H. Spooner of Boston, Francis H. Appleton of Peabody, Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, J. L. Ellsworth of Worcester.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, Geo. P. Carpenter of Williamstown, O. E. Bradway of Monson, J. Harding Allen of Barre.

Committee on domestic animals and sanitation: Messrs. Isaac Damon of Wayland, Oscar S. Thayer of Attleborough, Joshua Clark of Tewksbury, Johnson Whiting of West Tisbury, John S. Anderson of Shelburne.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, J. M. Danforth of Lynnfield Centre, John G. Avery of Spencer, Wm. R. Sessions of Springfield.

Committee on Dairy Bureau and agricultural products: Messrs. J. L. Ellsworth of Worcester, C. D. Richardson of West Brookfield, F. W. Sargent of Amesbury, C. B. Benedict of Egremont, W. M. Wellington of Oxford, A. M. Lyman of Montague.

Committee on Agricultural College and education: Messrs. John Bursley of West Barnstable, C. K. Brewster of Worthington, Wesley B. Barton of Dalton, W. C. Jewett of Worcester, Arthur A. Smith of Colrain.

Committee on experiments and station work: Messrs. Wm. H. Spooner of Boston, T. H. Goodspeed of Athol, N. I. Bowditch of Framingham, S. B. Taft of Uxbridge, Edmund Hersey of Hingham.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, J. S. Appleton of Nantucket, H. A. Turner of Norwell, E. W. Boise of Blandford, J. W. Gurney of Cummington.

Committee on institutes and public meetings: Messrs. F. W. Sargent of Amesbury, Edmund Hersey of Hingham, W. B. Barton of Dalton, Henry C. Comins of Northampton, H. H. Goodell of Amherst.

Which appointments were approved by the Board.

The secretary read a communication from Mr. WILLIAM G. CLARK on the subject of the use of steam power in agriculture.

Voted, That the communication be laid on the table, and that the secretary notify Mr. Clark of the action of the Board.

Second Vice-President PRATT called to the chair.

Mr. SESSIONS presented and read an essay on "Massachusetts forestry," which was accepted and ordered printed.

Voted, That the essay be referred to the executive committee and the committee on forestry, roads and roadside improvements, sitting jointly, with power to act.

General Appleton, for the committee appointed at the last annual meeting to devise and prepare for suitable recognition of the fiftieth anniversary of the founding of the Board, reported the following recommendations: —

We recommend that the offer of the Massachusetts Horticultural Society of the use of its hall for the meeting be accepted, with thanks.

That the Hon. George S. Bontwell, who is, by vote of the Board at the annual meeting in January, 1901, to be the guest of honor, be invited to address the Board at such time.

That the facts relating to the meeting be presented to Governor Crane, and that his pleasure in the matter be sought.

That an invitation be extended to Hon. James Wilson, Secretary of Agriculture, or such person as he may delegate to represent him, to participate in and address the meeting.

That President H. H. Goodell of the Massachusetts Agricultural College, and Dr. Pritchett, president of the Massachusetts Institute of Technology, be invited to address the meeting.

That all living past members and past officers of the Board be invited to participate in the meeting.

And this committee further recommends that the committee on legislation of the Board be authorized to ask for a sum of money with which to carry out this semi-centennial in a proper and dignified manner.

Respectfully submitted,

FRANCIS H. APPLETON,
For the Committee.

The report of the committee was accepted as a report of progress, and the committee was continued.

Mr. Kilbourn, for the committee on agricultural societies, reported recommending that the date for the commencement of the fair of the Eastern Hampden Agricultural Society be changed to the first Monday in September, that of the Hampshire Agricultural Society to the third Tuesday in September, that of the Marshfield Agricultural and Horticultural Society to the Wednesday preceding the first Monday in September, that of the Manufacturers' Agricultural Society in North Attleborough to the sixth Tuesday after the first Monday in September, that of the Nantucket Agricultural Society to the second Wednesday preceding the first Monday in September, and that of the Worcester Agricultural Society to the first Monday in September.

Voted, To change the dates of the several societies, as recommended.

Mr. JOHN BURSLEY presented and read an essay on "The influence of the Board on the agriculture of the State," which was accepted and ordered printed.

At 12.05 the Board adjourned to 1 p.m.

The Board was called to order at 1.15 p.m.

Voted, That the doings of the executive committee, acting for the Board, the past year, be approved and adopted as the actions of the Board.

Voted, That all unfinished business or new business arising before the next regular meeting of the Board be left with the executive committee, with power to act.

Voted, That delinquencies of societies in making required returns be referred to the executive committee, with full powers.

The Bay State Agricultural Society, by Mr. N. I. Bowditch, secretary, extended an invitation to the members of the Board of Agriculture and their friends to attend two institutes to be held at North Grafton the 22d instant and at Greenfield the 23d instant, on "Sheep husbandry," by Mr. James Wood of Mt. Kisco, N. Y.

Voted, That the secretary be authorized to engage Mr. E. H. Forbush to prepare a report on methods and seasons of pruning fruit, shade and forest trees, at an expense not exceeding fifty dollars.

Voted, That the matter of preparing and printing a monograph on the brown-tail moth, and the matter of a paper on insect-eating birds, be left with the secretary, with power to ask, in the name of the Board, for an appropriation for the purpose from the Legislature, if he deems it best.

The committee on institutes and public meetings, by Mr. Barton, reported recommending the appointment of Mr. A. A. Smith and Mr. W. C. Jewett as essayists for the next annual meeting of the Board.

Voted, To accept the report, and appoint the essayists as recommended.

The committee on institutes and public meetings, by Mr. Barton, reported recommending that the next public winter meeting be held at South Framingham, on invitation of the Middlesex South Agricultural Society.

The Hoosac Valley Agricultural Society, greatly desiring the meeting should be held at North Adams, Mr. Carpenter, their delegate, moved to amend the report of the committee by substituting North Adams. Mr. Damon, delegate from the Middlesex South Agricultural Society, having withdrawn the invitation of his society, the Board voted to hold the meeting at North Adams.

Voted, That the Chair appoint a local committee of five, to act with the secretary and the committee on institutes and public meetings, as a committee of arrangements for the public winter meeting at North Adams, Dec. 2-4, 1902.

The Chair appointed Messrs. Carpenter, Barton, Smith, Brewster and Gurney.

Mr. Kilbourn, for the committee on agricultural societies, reported recommending the assignment of inspectors, as follows : —

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|---|-------------------|
| Amesbury and Salisbury, at Amesbury, September 23, 24 and 25, | W. A. KILBOURN. |
| Barnstable County, at Barnstable, August 26, 27 and 28, | E. W. BOISE. |
| Berkshire at Pittsfield, September 9, 10 and 11, | C. D. RICHARDSON. |
| Blackstone Valley, at Uxbridge, September 9 and 10, | F. W. SARGENT. |
| Deerfield Valley, at Charlemont, September 11 and 12, | AUGUSTUS PRATT. |
| Eastern Hampden, at Palmer, September 1 and 2, | W. H. SPOONER. |
| Essex, at Peabody, September 16, 17 and 18, | H. A. TURNER. |
| Franklin County, at Greenfield, September 17 and 18, | J. L. ELLSWORTH. |
| Hampshire, at Amherst, September 16 and 17, | O. E. BRADWAY. |
| Hampshire, Franklin and Hampden, at Northampton, October 1 and 2, | N. I. BOWDITCH. |
| Highland, at Middlefield, September 3 and 4, | J. S. ANDERSON. |
| Hillside, at Cummington, September 23 and 24, | JOSHUA CLARK. |
| Hingham, at Hingham, September 23 and 24, | W. C. JEWETT. |
| Hoosac Valley, at North Adams, September 1, 2 and 3, | J. M. DANFORTH. |

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| Housatonic, at Great Barrington, September 24 and 25, | W. M. WELLINGTON. |
| Manufacturers' Agricultural, at North Attle- borough, October 7, 8 and 9, | J. H. ALLEN. |
| Marshfield, at Marshfield, August 27, 28 and 29, | ISAAC DAMON. |
| Martha's Vineyard, at West Tisbury, Septem- ber 16 and 17, | C. B. BENEDICT. |
| Massachusetts Horticultural, at Boston, Septem- ber 30 and October 1, | F. H. APPLETON. |
| Middlesex North, at Lowell, September 11, 12 and 13, | J. W. GURNEY. |
| Middlesex South, at Framingham, September 16 and 17, | A. A. SMITH. |
| Nantucket, at Nantucket, August 20 and 21, | Q. L. REED. |
| Oxford, at Oxford, September 4 and 5, | JOHNSON WHITING. |
| Plymouth County, at Bridgewater, September 10, 11 and 12, | A. M. LYMAN. |
| Spencer, at Spencer, September 18 and 19, | C. K. BREWSTER. |
| Union, at Blandford, September 10 and 11, | JOHN BURSLEY. |
| Weymouth, at South Weymouth, September 25, 26 and 27, | H. C. COMINS. |
| Worcester, at Worcester, September 1, 2, 3 and 4, | W. B. BARTON. |
| Worcester East, at Clinton, September 10, 11 and 12, | T. H. GOODSPEED. |
| Worcester Northwest, at Athol, September 1 and 2, | J. G. AVERY. |
| Worcester South, at Sturbridge, September 11 and 12, | O. S. THAYER. |
| Worcester County West, at Barre, September 25 and 26, | J. S. APPLETON. |

The report of the committee was accepted and adopted.

The records of the second day's meeting were read and approved.

The meeting was then dissolved.

JAMES W. STOCKWELL,

Secretary.

SPECIAL MEETING.

JANUARY 30, 1902.

[Inserted in this report because of its relation to the work and records of the annual meeting, January 7 and 8, 1902.]

SPECIAL MEETING.

A special meeting of the State Board of Agriculture was held at the office of the secretary, in Boston, on Thursday, Jan. 30, 1902, at 11 o'clock, First Vice-President SESSIONS presiding.

Present: Messrs. F. H. Appleton, Avery, Barton, Bursley, Boise, Carpenter, Clark, Damon, Danforth, Ellsworth, Goodell, Goodspeed, Gurney, Jewett, Kilbourn, Lyman, Hersey, Richardson, Sargent, Sessions, Smith, Spooner, Stockwell, Thayer, Turner and Wellington.

The meeting was called by request to consider the action of the Board at its annual meeting with reference to the Bristol County Agricultural Society.

Voted, Unanimously, not to reconsider the votes passed at the recent annual meeting with reference to the Bristol County Agricultural Society.

Voted, That a committee of three be appointed by the Chair, to confer with the representatives of the Bristol County Agricultural Society and the Weymouth Agricultural and Industrial Society, to see if some arrangement cannot be made whereby the difficulty may be overcome. The Chair appointed Messrs. Jewett, Barton and Richardson as the committee.

The secretary reported that the financial and premium returns of the Spencer and Worcester societies, and that the transactions of the Highland, Hillside, Middlesex North, Plymouth County and Worcester North-west societies, had been received since the 10th of January, with reasons for the delay, and it was

Voted, To excuse the delinquencies of these societies.

Voted, That the secretary be made a member *ex officio* of the committee on the fiftieth anniversary of the Board.

Voted, That the secretary be authorized to print in pamphlet form a revised edition of the laws relating to the State Board of Agriculture and incorporated agricultural societies, together with the by-laws of the Board and the rules and recommendations of the Board for the agricultural societies which draw State bounty.

Voted, That the matter of changes in the blanks for returns of the agricultural societies be referred to the committee on agricultural societies, with power to suggest changes.

Voted, To approve the amended Grout bill, and that the secretary be authorized and instructed to so notify the Massachusetts members of Congress.

Voted, That the Dairy Bureau be instructed to oppose the repeal or weakening of any of the State laws relating to the purity of dairy products.

Voted, That the Board oppose the suggestion that the third week in July be made an "Old Home Week," and that it suggest that the first or second week in August be a more desirable time.

At 1.20 the Board adjourned to 2 o'clock.

The Board met at 2 o'clock, Second Vice-President PRATT in the chair.

Mr. Jewett, from the committee appointed at the morning session, reported the results of a conference with the two societies specified, and it was

Voted, That the Bristol County Agricultural Society be authorized to hold its fair on the first four days in the last week in September.

Voted, That a committee of three be appointed by the Chair to prepare suitable resolutions on the death of the late member of the Board, Mr. Edward M. Thurston, to be placed on the records, and a copy sent to the family of the deceased.

The Chair appointed Messrs. Avery, Kilbourn and Spooner as the committee.

The committee subsequently reported the following resolutions:—

Resolved, That the death of our late associate, Edward M. Thurston, has brought sorrow to our Board, in the loss of an efficient, valued and active member, whose influence was always for good; whose genial, kindly ways made him always welcome, and always influential in all the measures coming under our consideration.

Resolved, That we place upon our records this tribute of our regard, and express to his family our kindest sympathy.

The meeting dissolved at 2.45 o'clock.

J. W. STOCKWELL,

Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 7, 1902.]

At the public winter meeting of the Board at Northampton your committee considered the reports of the several societies and found them satisfactory, and showing a good condition in most cases, with occasional exceptions where unfavorable weather had interfered with successful fairs, resulting in financial loss.

The one society that requires special consideration in this report is that of Bristol County, which held its fair at a date different from that assigned by the Board, and greatly to the interference with the success of the neighboring society of Weymouth, and losing its claim on the bounty of the State. The result to itself, in spite of a large attendance of people, was a net loss of \$2,000 to its treasury, and shows plainly the great risk which societies incur by providing expensive attractions.

The Board of Agriculture, in refusing to grant the change of date for holding the fair which the Bristol County Society asked last year, adhered to its established custom of refusing such change to the manifest disadvantage of a neighboring society. Your committee has no recommendation to make, unless the two societies interested can agree upon dates mutually satisfactory. We sincerely hope that they will so agree, and that the unfortunate experience of this year may not be repeated.

Respectfully submitted,

W. A. KILBOURN.

GEO. P. CARPENTER.

Q. L. REED.

CHARLES A. GLEASON.

REPORT OF COMMITTEE ON DOMESTIC ANIMALS AND SANITATION.

[Read and accepted at the Annual Meeting, Jan. 8, 1902.]

Your committee has held the meeting required by the rules of the Board, and begs leave to submit the following report. The work of the State on domestic animals and sanitation is largely in the hands of the State Cattle Commission, they having funds to work with which are not at the command of your committee; the work of this committee has therefore been confined to observation and consultation. The cattle industry in Massachusetts is mainly confined to milk and butter production, and the dairymen of the State have suffered under peculiarly trying circumstances this year in the very high prices which have prevailed for grain feeds. Nevertheless, it is the belief of this committee that the dairy interests of Massachusetts have, in view of the higher prices for milk which have also quite generally prevailed, been prosperous, on the whole, and the outlook for the future is as bright as ever. Certainly never have our dairymen done as much in the raising of soiling crops and of green fodder for the silo as in this year; and it is the earnest hope of this committee that they may return to the old-fashioned method of raising a goodly proportion of the grain which they consume on their own farms. The quality of the stock of the State is steadily going forward, and never was there more pure-bred stock on the farms of Massachusetts than to-day.

The question of sanitation of farm buildings has been one which has engrossed a great deal of attention for the past few years, and during that time great advances have been

made. At the present time it is the belief of this committee that the sanitary conditions of our farms, while by no means perfect, are continually advancing, and as good as reasonably could be expected.

Respectfully submitted,

ISAAC DAMON.

JOSHUA CLARK.

JOHN S. ANDERSON.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Read and accepted at the Annual Meeting, Jan. 8, 1902.]

A hasty examination of the Experiment Station shows that the professors have all that they can do in each department. Every year our Legislature is increasing the work of the station, and the time is near, if it has not already come, when the heads of the several departments will be compelled to confine their work to the Experiment Station. There are departments which would be very much improved if the whole time of the professors was given to the work of the station.

The Experiment Station will never be what it ought to be while its professors occupy two positions, — one as teachers in the college, and the other as heads of departments in the Experiment Station. The work is not alike. If a professor was called upon to speak to his class, he might be thinking of some new method of changing the earth so as to make the materials better adapted to plant growth, or the mixing of some chemicals which would kill an insect and save the tree, or perhaps he might be mixing some compound that would cheapen the production of milk.

The work which is now being given to some of the professors is of a character that interferes with their work at the station, and at the same time cannot be what it should be at the college. This is a fact that must be evident to every teacher who has had college work to do.

Respectfully submitted,

EDMUND HERSEY,

Chairman.

REPORT OF COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

[Read and accepted at the Annual Meeting, Jan. 7, 1902.]

Your committee has had no special task placed upon it by yourselves nor by the Legislature; and, as your first vice-president is to address us during this meeting upon "Massachusetts forestry," and is well informed as to its condition throughout the State, it seems to be out of place for us to report at any length upon this subject.

As to roads, the matter of the State's interest has been placed in the charge of the Highway Commission, which has funds at its command for the purpose and has skilled employees under its direction, so that it is unnecessary for us to cope with a subject so much better placed.

Forestry and arboriculture are receiving attention from the several park boards of the State in varying degrees of success, but greater than formerly; and they seek information from other sources that exist, and which have special opportunities of acquiring knowledge upon those lines. Schools of forestry, well established, are actively at work in Yale University, Cornell, Biltmore, N. C., and elsewhere; and we have as noted an exhibit of growth and study of trees at the Arnold Arboretum as probably exists. The effect of the tree warden law has been promotive of good, and has greatly increased intelligent interest in trees.

As to roadside improvements, the general interest has increased of late years. Better roads and the extension of street car service have encouraged travel among our people, who are taking far greater interest in the condition of our roadsides, and who are cultivating a decidedly healthy opinion that reasonable protection of their natural beauty and prevention of injury from local ignorance should receive

more careful public attention. This even has extended to opinions that individual owners have no right to allow injury to their own property to exist which brings injury to others. Hideous signs should be fought by crusades of instruction, and by advancing the idea of love of the beautiful and increased appreciation of the value of landscape purity.

I desire to refer to a great forestry work which is going on in this State, to the benefit of many people, indeed, for many generations into the future. While this great work is known in fact, it is too little realized in its vast details. It will become a great object lesson to all visitors. I can only lead up to and barely touch upon details at this time; nor is the forestry work there yet so formulated in report for me to have the knowledge that will enable me to do more than refer to what it must become; nor can it be said how far the public can be permitted to enter upon the great reservations of land, with their forest and other coverings, which are to protect the superb and extensive water basin that will exist at no very distant day in the Nashua River valley above Clinton.

The Nashua River water-shed is given as 118.23 square miles (75,667.20 acres). The area of the reservoir when full is 6.56 square miles (4,199 acres); its storage capacity is given as 63,068,000,000 gallons; depth of water near the great dam above level of existing mill pond is 107 feet, with an average depth of 46 feet; its high-water mark is 385 feet above the level of high tide. The natural hills, dikes and the great dam keep the water enclosed. "The top of the dam is 10 feet above the level of the full reservoir. At the water level it has a thickness of 19 feet, and 145 feet below this level a thickness of 119½ feet. The total distance across the valley on the line of the main portion of the dam, at high-water level, is 1,250 feet. The maximum depth of high water to the rock at the down-stream edge of the dam is 158 feet." The size of the dam is given, and its figures tell additionally of the extensiveness of the protection of, and receptacle for, this vast body of pure water for more than half the people of our State.

This shows you that, with a great necessary change in grades and character over the reservoir tract and far beyond in the 118.23 square miles of water-shed, a large amount of deforesting, reforesting and road building will be eventually completed. So you readily imagine that great problems on these several lines that are laid down by law as a care of your committee have been exemplified under the direction of the Metropolitan Water Board, with the best advice that they have been able to receive, and to the State's great good for all time. It will form a State park under their care, — first, for preserving the purity of that water supply, and second, as a delight to many people. For reforesting, nurseries of young trees are being fostered, and mother earth has been improved, when necessary and practicable, to encourage the young growth to become future forests of most useful form and character, which shall hold the earth in place and improve the general usefulness of the water-shed. The proper care of the older trees of natural growth becomes also a charge.

There appears to have been a comparatively small amount of damage by fire to woodlands during the past year, chiefly on account of the well-distributed rains during the time when dryness of underbrush and soil makes such injury possible. In forestry work the greatest discouragement and injury come from fires: and we should advise as great a division as possible of woodlands into separate tracts, by cart paths and roads and highways, in order to bring the possibility of preventing and ease of fighting such fires to the maximum.

Respectfully submitted,

FRANCIS H. APPLETON,

Chairman.

REPORT TO THE LEGISLATURE OF THE STATE
BOARD OF AGRICULTURE, ACTING AS OVER-
SEERS OF THE MASSACHUSETTS AGRICUL-
TURAL COLLEGE.

[Revised Laws, chapter 89, section 10, adopted by the Board, Jan. 7, 1902.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

Your committee has attended to the duties assigned it, and has visited the Agricultural College on two different occasions.

June 14 the "Grinnell prizes" were awarded as follows: the first prize to Nathan Justin Hunting of Shutesbury and the second prize to Ralph Ingram Smith of Leverett.

ENTOMOLOGICAL DEPARTMENT.

We are pleased to note the increasing interest in the entomological department. While it is but a very few years since the building was greatly enlarged, it was gratifying to see all of the desks filled with industrious pupils, anxious to learn more of the insects detrimental and useful to our farmers. That the worth of the graduate from this department is appreciated is proved by the responsible positions recently filled in the western States by men from this course. The same is true of the classes in botany, where the students are ever seeking for more knowledge of the fungous and rust diseases so detrimental to nearly all the fruits, vegetables and grains. This class room is also well filled,—an evidence that our people realize that, if we are to successfully cope with the great questions confronting the agriculturist of to-day, more and deeper study is necessary.

HORTICULTURAL DEPARTMENT.

The work of the horticultural department has been carried on in about the same lines of former years. The fruit crop has been good as a rule, the quality not as good as last year, but much better than the average. The plum and peach crops were larger, good in color, but not as high in quality. The grape crop was one of the best in size and quality, and one of the most profitable on the grounds.

New plantations of both large and small fruits have been made, and many new varieties have been added to all of the kinds; the largest number have been added to the plums and strawberries. Very thorough work was done in protecting the crops of fruit, vegetables, flowers, etc., from insects and fungous pests, with marked success. In many cases common illuminating kerosene was used in mechanical mixtures with the Gould pump, known as the "Kerowater," with good success for the aphides and scale insects.

Some very good results were obtained in thinning fruit, especially peaches, plums, grapes, etc. Many new seedling grapes and raspberries have fruited again, and some show remarkable promise. More work than usual has been done the past season in testing new ornamental trees, shrubs, vegetables, out-door flowering plants, greenhouse plants, etc.

VETERINARY DEPARTMENT.

The work of this department has been carried along as rapidly as funds would permit, on lines mapped out some years ago. The aim has been to develop more practically the educational part, as applied to the students and the agricultural public.

New apparatus has been added to the equipment, more especially the past year to the museum, which is of so much value in connection with class-room and laboratory work.

Much has been done through correspondence in giving advice as to the treatment of sick animals belonging to those who were so situated that the services of a competent veterinarian were not available. In many instances in this

connection specimens have been sent in for examination, to aid in making a correct diagnosis and to assist in prescribing for the treatment of the case. The department has every facility for the examination of specimens of this nature, and invites the farmers to send to it at any time material from diseased animals.

During the past year the photographing room in the main building has been equipped with apparatus, through the generosity of the Massachusetts Society for Promoting Agriculture, which appropriated a sum sufficient for the purpose.

THE FARM.

The farm work has been conducted along practical lines, and can give the farmers of Massachusetts one of the best object lessons, not only in seeing and learning the value of almost every agricultural implement that is on the market, but the value of clean culture, and the proper fertilization to secure a good crop. The experiments made there should be of great assistance to every student, as well as to the farmers in general. The beautiful field of clover last June was a delight to your committee. It demonstrated the fact that clover can be grown in abundance, providing the soil is supplied with the proper elements which produce it.

That the farm may become of more benefit, not only to the students but to all who visit the institution for the purpose of becoming familiar with the value of an agricultural education, your committee would recommend that a more representative herd of cattle be placed upon the farm as soon as practicable.

SHALL THE MASSACHUSETTS AGRICULTURAL COLLEGE LIVE?

Looking back after nearly forty years of the existence of the Agricultural College, we may discover here and there a mistake, but on the whole much of success. When debts have accumulated and needed improvements have been delayed by want of State appropriations, the friends of the college have rallied to its rescue, and, though all has not been done that should have been, yet each decade has shown a steady improvement.

In other States, listening to the demand of a sickly sentimentalism, the agricultural school has been submerged in another institution or crowned by another name and its identity lost. Even here in Massachusetts there goes up the annual cry, Drop the word agricultural, and give the college a more pleasing name !

So much has been said within the past few weeks, both at the annual winter meeting of this Board and in the public press, that we leave from our report much that had been previously written along this line, and give instead a brief summary.

God's first gift to created man was the earth, saying : " Be fruitful, multiply and replenish the earth, dress and keep it." How well man has obeyed the divine precept is shown by the land being cursed by thorns and briers, blight and mildew and innumerable insect pests.

Man also built a city, and a few got rich ; thousands of others saw the glitter, left the land and followed, only to reap poverty and want.

It is largely from the city and large village that the cry comes up, Drop the name agriculture, — this one name, that is at the base of all living and all industry, and, may we not add, requiring an education, when it is thoroughly understood, beyond that of any other known profession.

In the last twenty-eight years fifty-six Grinnell prizes in agriculture have been awarded to students, forty-five of which were awarded to students residing in towns and only eleven to students residing in cities.

One may study books, but to make it effective he must work with his hands. The chemist, the architect, the painter, the mechanic and all laborers, either of head or hands, must make a practical application of their studies, or they come to naught. More than all these, the successful farmer of the future must have the knowledge that comes of applied chemistry. An educated man is needed quite as much on the farm as in the laboratory, the counting room or in the professor's chair. What good is a theoretic sculptor who never used a chisel, or a well-read painter who never used a brush? One cannot be separated

from the other ; neither can the hands of a truly educated farmer be separated from the soil.

We may say to all connected with the college : Be not governed by or listen to old wives' fables or long-ago exploded ideas. Idealists come and go ; but truth, though buried in the earth, abides forever. Seek and find it.

These old New England hills yet hold more riches for the world, in thought, study, capabilities and availabilities, than do the gold fields of Alaska. Draw near to mother earth, from whence we came and whither we go, and learn of her.

It is not too vast for our present conception. We already see glimmerings of the coming day. In earth, air and sea we find the key to the great megaphone that not only holds the earthquakes, the thunderings and the lightnings, but also the whisperings and gentle breathings of the long-past and dying ages. To accomplish this, let the college do the work, the State pay the needful bills ungrudgingly. Nail agriculture to the flag staff, and let " Aggie " live on and on.

JOHN BURSLEY.

C. K. BREWSTER.

WESLEY B. BARTON.

ALVAN BARRUS.

W. C. JEWETT.

REPORT OF COMMITTEE ON INSTITUTES AND PUBLIC MEETINGS.

[Read and accepted at the Annual Meeting, Jan. 7, 1902.]

Not the least important work of the Board of Agriculture is the educational or institute work. Your committee having this in charge have given much thought and consideration to the matter of institutes and public meetings. The list of lecturers has been carefully revised and several new names added, and the subjects named by the lecturers thoroughly considered, with the result that we believe no better or more complete list has ever been offered to the agriculturists of any State. We believe that such talent as is hereby offered should be more highly appreciated by the communities in which the institutes are held; and we would urge upon every member of this Board the importance of large audiences at each and every meeting, and that it is one of the duties which you owe to your respective societies and the State that the institutes be of the highest class, and that you do all in your power to make them such.

As this work is strictly for the promotion of agriculture, we would urge that only subjects kindred to agriculture be selected; and, when the lecturer who is paid by the State is before his audience, that all possible information should be drawn from him on the subject on which he is advertised to lecture; and we are free to say that we believe no man should go before any audience of the farmers of the State, as an educator, with any secrets of his subject which he is not willing to freely give.

We believe that those societies whose meetings are attended by a small number should have some revival work

done among them, in order that more benefit may be derived for the money spent.

There have been 128 institutes held during the year, 118 under the societies represented on the Board, and 10 under other organizations, where there was no agricultural society to take charge of the meeting and where the circumstances seemed to warrant. The average attendance at the institutes was 107, against 91 last year and 94 in 1899. At 6 meetings the attendance was over 300, at 19 from 200 to 300, at 33 from 100 to 200, at 33 from 50 to 100, and at 36 less than 50.

The attendance at the institutes of the various incorporated societies was as follows: Amesbury, 75, 70, 40, 85; Barnstable County, 35, 100, 65; Berkshire, 40, 35, 21; Blackstone Valley, 30, 25, 50; Bristol County, 200, 50, 30; Deerfield Valley, 65, 40, 250, 100; Eastern Hampden, 40, 100, 75; Essex, 60, 75, 115, 125; Franklin County, 60, 65, 15; Hampshire, 300, 30, 40; Hampshire, Franklin and Hampden, 50, 100, 200; Highland, 15, 130, 40; Hillside, 25, 100, 250, 40; Hingham, 30, 54, 35, 125, 60, 42; Hoosac Valley, 25, 15, 17; Housatonic, 10, 50, 50; Manufacturers', 250, 75, 200, 200; Marshfield, 100, 80, 68; Martha's Vineyard, 75, 25, 47; Massachusetts Horticultural, 125, 175, 350, 200, 250, 200, 175, 200, 200, 175; Middlesex North, 200, 200, 225, 125; Middlesex South, 175, 50, 19; Nantucket, 13, 7, 17; Oxford, 300, 175, 150; Plymouth County, 50, 55, 200, 35; Spencer, 53, 47, 42; Union, 300, 275, 180; Weymouth, 25, 100, 25; Worcester, 120, 180, 400; Worcester East, 320, 50, 74; Worcester North-west, 143, 125, 176; Worcester South, 45, 53, 145; Worcester County West, 50, 75, 100.

Of the lectures delivered at the institutes, 107 were by speakers selected from the list of speakers prepared under the direction of the committee on institutes and public meetings, and 37 were local speakers, or speakers who were not upon our list.

The summer or field meeting of the Board, held in August, was very successful, and the lectures before the Board on that occasion were perfect masterpieces. There

should be a larger attendance of the farmers of the State at these meetings, and we would suggest that more advertising to the public be done on future occasions.

Attendance at the Public Winter Meeting.

| | |
|--|-----|
| First day (3 sessions), average, | 135 |
| Second day (3 sessions), average, | 140 |
| Third day (1 session) (estimated), | 750 |
| Daily average (5 sessions), | 265 |
| Evening average (2 sessions), | 120 |
| Average attendance (7 sessions), | 225 |

The public winter meeting of the Board at Northampton was of that high class that adds increased interest to the agriculture of Massachusetts, and we believe that no better lecturers have ever been engaged by our members.

Respectfully submitted,

F. W. SARGENT,
Chairman.

REPORT OF COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.*

[Read and adopted at the Annual Meeting, Jan. 7, 1902.]

Your committee on gypsy moth, insects and birds begs leave to submit herewith a report on its work during the past year.

The action of the Legislature of 1900 in refusing further appropriations for the continuance of the effort to exterminate the gypsy moth necessitated the abrupt abandonment of all field work. By chapter 378, Acts of 1901, your committee was directed to sell the apparatus and supplies in its charge. A large and valuable part of the apparatus, including engine, spraying pumps, ladders and other appliances most useful in combating the moth, was turned over to the Metropolitan Park Commission, for use in the infested park lands. This Commission also took charge of some of the tools and apparatus that could not be sold at auction at a fair value, and which were valuable in fighting this pest. The remainder was sold at a duly advertised public auction, the proceeds of the sale being paid to the Treasurer of the Commonwealth. The records of experiments and work accomplished since 1891, maps showing the infested areas, and other documents of permanent value, are preserved in the office of the secretary of the Board. There has been but slight actual loss to the Commonwealth in the disposal of this property, so large a part of it having been simply transferred to another State department, where it will be available for immediate use.

This committee has felt it a duty to keep informed concerning the increase and spread of the moth, and to this end has made several visits to the infested region. From these examinations and from the voluntary reports of former em-

* House Document, No. 252, 1902.

ployees it is able to present a summary of the condition of the district now occupied by the gypsy moth.

To better understand the present situation, it may be well to review the condition of the infested territory at the close of the work, Feb. 1, 1900. At that date there were no large colonies of the moth in existence. The residential districts, always under close supervision, had been cleared from the moth, except for a few scattered infestations. The large woods colonies, which in previous years had so seriously menaced the work of extermination, had been subjected to most thorough treatment and the numbers of the moth reduced to a minimum.

To-day all is changed. For two years the moth has been allowed to multiply unchecked, and the increase of the pest has been of a most serious nature. The woodland colonies, so well under control in 1899, are becoming thoroughly re-infested. The struggling moths which might have been found and destroyed in 1900 have multiplied to such an extent that in nearly all of these colonies from Lexington to Lynn numbers of egg-clusters can now be seen. Some of the most important of these colonies are in the Fells reservation of the metropolitan park system, and here most strenuous efforts will be adopted, we believe, by the Metropolitan Park Commission, to prevent serious damage next summer.

A natural sequence of this increase of the moth in woodlands is the reinfestation of residential districts. The woodlands are cut up by many roads and are much frequented for pleasure driving. Since the caterpillars spin down on teams, there can be no doubt that much of the reinfestation of thickly settled districts is due to the increase of the moth in these colonies. Throughout Melrose, Medford, Malden and Everett, for example, the egg masses of the moth are now conspicuous objects on many streets. From the general and increasing infestation of the entire district we are led to fear that soon, unless preventive action is taken, the scenes of the historic outbreak of 1889-90 will be repeated, on an even larger scale.

We regret to report that during the past summer an extensive colony of the moth was found in Providence, R. I., this

being the first actual finding of the moth in this country outside of this Commonwealth. Upon invitation of the Rhode Island authorities, the colony was examined by the Secretary and A. H. Kirkland, M.S., former assistant entomologist to this committee. It was found that the infestation consisted, not, as might have been expected, of one large, strong colony, but rather of many small, distinct infestations, of practically the same age, scattered over some four or five square miles in the residential part of the city. To those familiar with the habits of the moth, it is evident that this condition of affairs could not have arisen from natural causes. Every circumstance yet discovered indicates that the moth was deliberately taken to Providence and purposely scattered by some malicious or irresponsible person.

THE BROWN-TAIL MOTH.

This insect has spread rapidly throughout eastern Massachusetts, and, in fact, is now known to occur in New Hampshire and Maine. Although chiefly a pest of the pear and apple, it has seriously injured shade trees in many localities. The most distressing feature of the spread of this insect is not the damage done to trees, — sufficiently serious of itself, — but rather the intense nettling caused by the caterpillars whenever they come in contact with human flesh. This irritation results in severe suffering, particularly among children. So severe was this affliction in the Brighton and Allston districts last summer that a public hearing was held by the Boston board of health to discuss the subject.

OTHER INSECTS.

The notable damage wrought by the elm-leaf beetle in our larger cities and towns is entitled to more than passing mention. For some five or six years this insect has been increasing in numbers and extending its domain in the State. Where neglected, its numerous progeny soon defoliate even the largest elms, and the death of the trees ultimately results. At Springfield, Northampton, Worcester and elsewhere, a high degree of success has been obtained by thoroughly spraying the trees with arsenate of lead early in the season, as soon as the leaves unfold.

The San José scale is unfortunately generally distributed throughout the State. Being disseminated originally in nursery stock, it has now spread to native trees, and in some localities has caused severe loss. No more deadly foe to nursery or orchard trees has ever reached our shores, infested trees being killed outright in a few years. The remedies most in favor at present are a thorough winter spraying with potash whale-oil soap, two pounds to one gallon of water; or the application of twenty per cent kerosene and water spray. Whichever remedy is used, the tree should be severely trimmed before spraying. Nursery stock should bear an official certificate of inspection.

Increasing damage by these pests has a deep significance for the farmer and property owner. They levy no small tax on the products of the soil. In the districts where they occur, the cost of crop production must necessarily increase. Correct information concerning their habits and remedies for combating them is one of the pressing needs of the hour. Equally necessary for success is the ability and disposition to put this knowledge into practical use.

AUGUSTUS PRATT.
FRED W. SARGENT.
JOHN M. DANFORTH.
JOHN G. AVERY.
WM. R. SESSIONS.
JAMES W. STOCKWELL.

FINANCIAL STATEMENT FOR 1901, GYPSY MOTH COMMITTEE

| | |
|--|------------|
| Appropriation for 1901, | \$1,000 00 |
| Teaming and livery, | \$61 50 |
| Wages of employees, | 368 75 |
| Rent of office and storehouse, | 262 00 |
| Supplies, printing, etc., | 94 04 |
| | <hr/> |
| | \$786 29 |
| Balance on hand Jan. 1, 1902, | 213 71 |
| | <hr/> |
| | \$1,000 00 |

*Goods and Material in the Custody of the Gypsy Moth Committee of the
Massachusetts State Board of Agriculture, 17 Russell Street, Malden,
turned over to the Metropolitan Park Commission, July, 1901.*

| | |
|---|------------------------------------|
| 3 hydrometers. | Pencil sharpener. |
| 203 small brushes. | Small clock. |
| Blocks and fall (2 sets). | 41 climbing irons. |
| White paint (52 cans, 2 pounds each). | 22 tuller scrapers. |
| 247 cleaning knives. | 19 pointer trowels. |
| 1 pair chemical balances. | 22 garden trowels. |
| 2 grindstones and frames. | 3 bellows. |
| Set of branding irons (1-10). | 20 bill hooks. |
| Linen tape line (100 feet). | 12 box openers. |
| 2 one-inch bits; also 1 1¼ inch bit. | 19 iron wedges. |
| Bit brace. | 8 mattocks. |
| Nine-inch smoothing plane. | 7 monkey wrenches. |
| One-inch wood chisel. | 11 iron spigots. |
| Worn-out files. | 5 stone mauls. |
| 1 pair end wire cutters. | 24 crowbars. |
| 2 sets dies (1-10). | 2 draw knives. |
| Bench vise. | Lawn mower. |
| 2 wood vises. | 8 cheese knives. |
| Hand screw. | 7 scythe stones. |
| 2 screwdrivers. | Chain (14 pieces, about 100 feet). |
| 2 one-inch augers; also 1 ½ inch auger. | Box opener and nail puller. |
| 26 spray nozzles. | Special hatchet. |
| 11 burning nozzles. | 39 ship scrapers. |
| 83 hand saws. | 72 bush scythes. |
| 1 pair grocer's scales. | 8 cross-cut saws (2 handles). |
| 2 printing frames. | 2 cross-cut saws (1 handle). |
| Drawing board. | Iron mortar and pestle. |
| 3 waste baskets. | Hoe. |
| 2 field glasses. | 510 axes. |
| 3 lamps. | 312 bush hooks with handles. |
| Small box. | 117 bush hooks without handles. |
| Shelf with hooks. | 43 scythe snaths. |

- 13 lightning cutters.
- 48 pitchforks.
- 45 garden rakes (21 without handles).
- 9 spades.
- 6 axe-eye hooks.
- 11 chairs.
- 2 chairs with arms.
- 4 revolving chairs.
- Typewriter stool.
- 4 stools.
- 2 roll-top desks.
- 2 typewriter desks.
- 4 flat-top desks.
- 4 tables (map table, index table, small table).
- Settee.
- Duplicating machine.
- 48 hatchets.
- 12 axe-eye hatchets.
- 18 hand axes.
- 18 sickles.
- 23 claw hammers.
- 30 tinning shears.
- Twine ($5\frac{1}{2}$ barrels).
- 4 insect-breeding cages.
- Pail of corks (542).
- 5 large tool boxes.
- 11 spraying outfits (carriage, tank and pump; also 1 broken pump).
- 10 small tool boxes.
- Well-driving weight.
- Keg nails.
- 379 mirrors.
- 6 drinking pails and dippers.
- 28 hand carts.
- 6 oil tanks (wood).
- 2 G. I. oil tanks.
- Creosote mixture (5 barrels).
- Tar (5 pails).
- 216 pruning cutters.
- Water tank (285 gallons).
- Stove.
- Heating drum.
- 22 burlap winding machines.
- 24 opera glasses.
- 35 ladders.
- 252 sheath knives.
- 183 sheaths.
- 411 belts (24 plus trunk full).
- Box of lap boards.
- 2 brooms.
- 20 lengths $\frac{1}{4}$ inch water hose with couplings (new).
- 16 lengths $\frac{1}{4}$ inch water hose without couplings (new).
- 2 lengths $\frac{1}{4}$ inch water hose without couplings (old).
- 18 lengths $\frac{1}{4}$ inch water hose with couplings (old).
- 373 P & C tubes.
- 11 spray poles.
- One-fourth inch pipe, iron (684 feet).
- G. I. oven.
- Burlap (about 500 pounds).
- 15 tar brushes (new).
- 51 tar brushes (worn out).
- 52 ladder ropes.
- 13 pieces $\frac{1}{2}$ inch rope, from 7 to 102 feet.
- 1 piece $\frac{5}{8}$ inch rope, 108 feet.
- 1 piece $\frac{3}{4}$ inch rope, 100 feet.
- 7 pieces 1 inch rope, 200, 75, 85, 105, 100, 50, 40 feet.
- 1 piece $1\frac{1}{4}$ inch rope, 117 feet.
- 78 lantern globes.
- 108 jelly glasses.
- 37 16-ounce bottles.
- 11 glass jars.
- 2 boxes homeo vials.
- Porcelain mortar and pestle.
- Miscellaneous glassware.
- 24 pounds Paris green.
- Miscellaneous chemicals.
- 11 ladder straps.
- 13 ankle straps.
- Irons and castings for pumps.
- Wool pitch ($\frac{1}{4}$ barrel).
- Horse sprayer.
- 111 duck caps.
- 170 worn-out caps.
- 545 havelock caps.
- Blacksmith's forge.
- 7 brass locks and keys.
- Miscellaneous locks and keys.
- 5 new hand saw handles.
- 2 scuffle hoes.
- 10 new pitchfork handles.
- 10 new ship scraper handles.
- 12 new pieces for extension poles.
- Typewriter.
- Ladder stand.
- Box of brown-tail moth reports.
- 88 galvanized-iron pails.
- 7 wooden spigots.
- Box of iron straps for bush hooks.
- Boiler and engine, fittings and shafting.
- 17 iron locks and keys.
- Blackboard.
- Branding iron (Massachusetts Board of Agriculture).
- Burlap cutting machine.
- 2 copper oilers.
- 1 gallon cylinder oil.
- 2 iron oilers.
- Wire brush.
- 2 burlap saws for machine.
- 14 fiber pails.
- Blower for forge.
- Scrap iron and steel.
- Boatswain's chair.
- Small cabinet for photos.
- 2 pigeon holes.
- Eight-day clock.
- 6 grindstones (worn out).
- Moulton's apparatus (no value).
- Coal shovel.
- 219 gossamer covers.
- 3 drinking dippers.
- Watering pot.
- Small stove.

*Articles transferred from the Office of the Gypsy Moth Committee at
Malden to the Office of the State Board of Agriculture.*

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|---------------------------------------|---|
| Maps of infested towns. | 1 pencil sharpener. |
| 2 caterpillar inflaters. | 1 cabinet for section books. |
| 851 badges. | 1 cabinet for report files. |
| 1 Brooks document filing cabinet. | 2 waste-paper baskets. |
| 1 Lang document filing cabinet. | 2 pairs field glasses. |
| 1 index cabinet. | Books on entomology. |
| 1 book case. | Maps, records, notes and other mem- oranda, with cases for same. |
| 2 tin index cases. | 1 typewriter. |
| Letter scales. | Stamped envelopes, which were ex- changed for postage stamps, to the value of seventy-five dollars. |
| 1 Webster's International Dictionary. | |
| 1 French dictionary. | |
| 2 botanical cabinets. | |
| 1 box and lock. | |

Articles turned over to the Massachusetts Agricultural College.

| | |
|----------------|--------------------------------|
| 1 museum case. | 1 cabinet of infested objects. |
|----------------|--------------------------------|

*Statement of Money received for Second-hand Material, Furniture and
Tools, sold at Auction and the Receipts paid to the Treasurer of the
Commonwealth, under Chapter 378, Acts of 1901.*

| | | | |
|---------------------------------------|---------|------------------------------------|----------|
| Caps, | \$11 00 | 84 sheath knives, | \$3 50 |
| Chemicals, | 125 00 | 96 ladders, | 101 06 |
| Junk, | 34 43 | Lot broken ladders and boards, | 2 30 |
| Old hose, | 50 | 1 microscope, | 20 00 |
| Toilet paper, | 2 90 | 1 oil stone, | 50 |
| 3 book cases, | 14 75 | 6 pairs opera glasses, | 13 50 |
| 1 cabinet for files, | 1 00 | 7 palls, | 70 |
| 1 card index case, | 60 | 108 pitchforks, | 11 70 |
| 8 chairs, | 7 40 | 18 garden rakes, | 2 25 |
| 4 desks, | 31 25 | 1 saw-filing vise, | 1 10 |
| 1 foot rest, | 01 | 35 hand saws, | 9 00 |
| 7 hassocks, | 10 | 12 pruning saws, | 1 15 |
| 1 row of hooks, | 05 | 24 scythe snaths, | 3 80 |
| 1 map case, | 50 | 39 pairs tinning shears, | 6 52 |
| 4 sets pigeon holes, | 90 | 24 ship scrapers, | 3 40 |
| 14 rugs, | 17 16 | 4 shovels, | 16 |
| 1 screen, | 30 | 18 sickles, | 2 49 |
| 3 tables, | 2 65 | 1 spirit level, | 60 |
| 2 wardrobes, | 5 50 | 1 spoke shave, | 10 |
| 5 waste-paper baskets, | 75 | 12 spraying nozzles, | 20 80 |
| 1 Welsbach burner, | 25 | 16 spraying outfits, | 222 00 |
| 258 axes, | 37 70 | 1 bevel square, | 10 |
| 12 bill hooks, | 90 | 1 iron square, | 10 |
| 6 box openers, | 70 | 11 small tool boxes, | 2 20 |
| 10 burning nozzles, | 7 50 | 3 medium tool boxes, | 66 |
| 17 burning outfits, | 14 00 | 15 large tool boxes, | 10 10 |
| 145 bush hooks, | 9 05 | 24 garden trowels, | 1 40 |
| 18 bush scythes, | 1 05 | 10 mason trowels, | 1 00 |
| 13 brass locks and keys, | 80 | 18 pointer trowels, | 2 10 |
| 44 flat chisels, | 2 16 | 2 trucks, | 12 00 |
| 25 pairs climbing irons, | 8 33 | 1 typewriter, | 25 00 |
| 1 emery stone and fittings, | 8 25 | 2 wheelbarrows, | 3 65 |
| 1 grindstone, | 50 | 4 wrenches, | 30 |
| 24 claw hammers, | 2 40 | | |
| 75 hatchets, | 15 63 | Total, | \$851 77 |
| 1 Johnson pump, | 65 | | |

REPORT OF THE LIBRARIAN.

[Read and accepted at the Annual Meeting, Jan. 7, 1902.]

To the Secretary of the Board of Agriculture.

SIR: — The fifth report of the librarian is herewith presented.

The expenses incurred on account of the library in 1901 and paid from the appropriation for “incidental expenses in the office of the secretary” were as follows: books and pamphlets purchased, \$58.03; current publications subscribed for, \$27.50; binding, \$35.15; total, \$120.68.

One hundred and fifty-eight volumes were added to the library in 1901, making the total number of bound volumes 3,451.

The loaning of books has been continued, and during the past year 23 persons availed themselves of the privilege, — an increase of 6 over 1900. Forty-three books were loaned, — a decrease of 3 over 1900. These books covered quite a range of subject matter, 23 sections of the library being represented in the loans. The sections predominating in the loans were: agriculture, 6; horticulture, 4; field crops, 3; insects, 3; dairying, 3.

The past year has witnessed the completion of the task of compiling copies of laws relating to agriculture, horticulture, etc., and to organizations having those interests in charge, referred to in the librarian's report of January, 1898, and there is now in the library a bound volume containing copies of laws, as follows: —

State Board of Agriculture, 1852–1901.

Massachusetts Agricultural College, 1863–1901.

Massachusetts Agricultural Experiment Station, 1882–1895.

Agricultural societies, acts of incorporation, etc., 1791–1901.

Agricultural societies, general laws, 1819–1901.

Board of Cattle Commissioners, 1860–1901.

General agricultural laws, 1783–1901.

This volume also contains reference lists of other laws, as follows: dairy, 1785–1901; horse, 1788–1901; dog, 1791–1901; forestry, 1853–1901; fertilizer, 1869–1901.

A companion volume has been prepared, in which to preserve copies of similar laws, beginning with the year 1902.

Considerable material of historical interest, particularly that relating to the State Board of Agriculture, has been collected, and there is now in the custody of the librarian much data which may prove of value should a history of the Board or of other agricultural organizations be written. The librarian has in mind the preparation of what might be termed a history of organized agriculture in Massachusetts in the nineteenth century, for preservation in the office, or for publication, as the Board might determine. A brief history of the movement leading up to the formation of the State Board of Agriculture has already been compiled; also data covering the first ten years of the Board's existence.

Respectfully submitted,

F. H. FOWLER,
Librarian.

MASSACHUSETTS FORESTRY.

BY HON. WM. R. SESSIONS OF SPRINGFIELD.

This subject was assigned to me, as I understand, not because I am an expert in forestry, or even a student of the subject, but because at the last annual meeting of the Board I advanced some suggestions for future action by the State that might lead to practical work in the line of forestry ; work that might help future generations out of the present unfavorable conditions that have been brought upon us by the management of the woodlands of the State by the owners of such property. It was doubtless expected that I would in this paper elaborate a plan for the suggested State action. I am not prepared to do so, but may be able to state facts and present further suggestions that may serve as hints to students of the Massachusetts forest problem, or at least more fully explain the position assumed at the last annual meeting.

I think it will be agreed that it is folly to expect owners to expend money in planting trees, or in fostering the growth of timber from the spontaneous growth of our woodlands and neglected hillsides. Our people are unwilling to invest money for the benefit of posterity, with no expectation of an annual income or for any return during their lifetime. There are several reasons why this condition prevails. If a man should decide to grow a timber forest, he could have little hope that his children would be owners of the property when it was ready to furnish a financial return for his investment in land and care of forest. The owners of our woodlands and abandoned pasture lands are very largely men of small means, who cannot afford any outlay that does not offer a reasonable prospect of a return in the shape of an income on the investment during their

own lifetime. The majority of such owners are well advanced in years, and must, if possible, get something out of their property to support them in their declining years. All property is subject to taxation, that which affords no income as well as that which gives an annual return. As woodland increases in value by growth, the taxes are increased, until the owner with small means is practically compelled to cut the wood as soon as he can get anything for it. He can hardly wait for railroad ties, much less for valuable timber and other lumber. He *cannot* consider the public welfare, though he may be well aware that the covering of his land with mature forest growth is necessary for the conservation of the water supply for the centres of population and for the maintenance of a steady flow of the streams that furnish water power to numerous manufacturing establishments, so necessary to the prosperity of the State and which furnish employment to the working people. It is said to be folly to preach Christianity to a starving man. It is equally foolish to urge the benefit to the community from hillsides covered with a mature forest growth, when the owner must get something from those hillsides to pay the taxes on them and to help "keep the wolf from the door." As long as present conditions continue, just so long will the cutting of immature tree growth continue, and our hillsides will bear only a covering of sprouts and brush. The flow of our streams will continue to decrease except in time of freshets, and the problem of water supply for our cities will cause more and more anxiety to all those who feel a responsibility for the welfare of those who will come after us.

Doubtless something should be *done*. Preaching will not avail. The owners cannot do it, and, if they were financially able, would not feel under obligation, as a class, to make sacrifices for the good of the community and posterity. The community should pay its own bills. Our State has always recognized the fact that it was under obligations to provide for the necessities of the people and for the good of posterity in the matters of education, support of the poor and care of the insane; and in later years for water supply,

sewerage and public parks, as well as for cheap transportation and convenient harbor accommodations. What is more logical than that the provision for future generations in conserving our water power and water supply should be undertaken by the State, in providing mature forest cover for the hills from which the streams receive their supply of water? In most European countries this burden was long ago assumed by the several governments, and was considered of so much vital importance that wars, conquests and revolutions have in nearly all countries left the policy in this regard unchanged. According to a paper read before the American Economic Association in 1890, 26 per cent, or 34,353,743 acres, of the surface of the German empire is covered with forest; and the State either owns or controls about two-thirds of this enormous area, or 22,902,495 acres. In France 17 per cent of the surface is wooded area, and nearly one-third of the same, or 7,373,068 acres, are either owned or controlled by the government.

In addition to the forest owned or controlled, most European governments maintain a rigid oversight of the forests owned by individuals. The owners can only cut their wood and timber under government regulations. These regulations generally require the present area of forest to be preserved intact, and compel owners to plant trees, if necessary, to replace such as they are allowed to cut. The government stands ready to purchase, at a fair price, any forest lands that the owners wish to sell, thus saving owners from severe loss from government regulations.

It is true that early conditions in Europe were much more favorable to government ownership and control than those of this State at the present time. Fernow says: "In Europe, thanks to a certain feudal system, large forest areas were preserved, more or less intact, in strong controlling hands, until the territory was gradually covered by a dense stable population, which necessitated conservative utilization of all resources and careful adjustment of private and communal interests."

The conditions in Massachusetts are radically different. All the forest lands are divided into comparatively small

private holdings, and until these conditions are changed nothing of moment can be accomplished in conserving the forests for the public good, for in this country private owners will not submit to such strenuous rules as are in force in European countries. One condition is in a large degree favorable. The face of the country in this State is so broken and uneven that an abundant portion of the surface has been left without clearing, and thousands of acres that were cleared by our fathers are of so little value as cleared land that they may be cheaply bought and added to the forested area. According to our last census, about 35 per cent of the surface of the State is classed as woodland, and in addition there are many thousands of acres of poor bushy pasture that might well be bearing trees. If all this land was covered with mature forest growth instead of the brush and sprouts that now occupy so large a portion of it, the future of the water supply of the State would be assured so far as the presence of abundant forest areas could assure it.

It has been urged that the forest problem, so far as regards the propagation of commercial timber, should be left to private enterprise; with the suggestion that outside capital would eventually be invested in large areas, which, while acquired primarily for game preserves or private parks, would be likely to be managed by their owners in a way to promote the growth of commercial timber and incidentally help to conserve the water supply. From my point of view, while this outcome would be an improvement on the present condition of our forests, it is objectionable in that it would tend toward the establishment of a landed aristocracy, which is not in accord with the traditions of our Commonwealth. It is also directly contrary to the growing idea that the land is God's gift to the people. To my mind it would be far better if a large part of the great area of wooded land, waste land and semi-waste land in our State was owned by the State, and that whatever of financial return could be realized therefrom in the future should benefit the inhabitants as a whole.

At first thought this may seem impracticable if not im-

possible, and it may seem that the State would be unable to bear the financial burden that the purchase of such an enormous area would impose. The last State census gives the value of all the woodland in the State at something less than \$24,000,000. This is a large sum, but when we remember the millions the State so freely spent in building the Hoosac Tunnel to better the transportation facilities of Boston and the eastern part of the State, and the other millions expended for additions to the State House and for the small open spaces about it, it may not seem such an enormous undertaking. We should also remember that the \$24,000,000 covers the valuation of about 1,500,000 acres of land, and that it includes the 414 acres of woodland in Suffolk County, at a valuation of almost \$1,000,000, or about \$2,200 per acre; also that of Essex, Middlesex and Norfolk, where the valuation is very much higher than that of the rest of the State, for the obvious reason that most of the woodland in these counties lies in close proximity to cities and large towns. The census valuation of woodland in the other counties is much less per acre, and the field of State experiment in forest ownership would naturally be largely in these other counties. The valuation of all the woodland in nine of the counties, viz., Berkshire, Franklin, Hampshire, Hampden, Worcester, Bristol, Plymouth, Barnstable and Dukes, is about \$15,840,000. If we leave out of this total the value of the comparatively few acres that have been artificially planted to forest and are naturally valued highly by their owners, we shall have in these nine counties 279,030 acres of wood of over thirty years' growth, valued at \$6,270,699, or an average of \$22.12 per acre; and 800,012 acres of wood of a growth of thirty years and under, valued at \$8,718,393, or an average of \$10.90 per acre. In addition, there are large areas of land in these counties given in the census as unimproved, unimprovable and unclassified. These are mostly cheap lands, and would doubtless be generally suitable for forest growth. There are of these classes of land in those counties 302,562 acres, valued at \$2,218,688, or an average of \$7.33 per acre. In the nine counties under consideration there are 1,102,574

acres of wood of thirty years growth or less, unimproved, unimprovable and unclassified lands, valued at \$10,937,081, or an average of about \$10 per acre.

By further examination of the census we shall find that there are large areas of land valued at a much cheaper rate. If we consider the cheaper classes in only the four western counties, leaving out the wood of over thirty years' growth, we find in Berkshire County 188,207 acres, valued at \$1,289,909, or an average of \$6.85 per acre; in Franklin County 145,154 acres, valued at \$873,645, or an average of \$6.02 per acre; in Hampshire County 110,822 acres, valued at \$879,689, or an average of \$7.94 per acre; in Hampden County 122,980 acres, valued at \$1,183,807, or an average of \$9.63 per acre. Taking the four western counties together, there are 567,163 acres, valued at \$4,227,050, or an average of \$7.47 per acre. These figures, it must be remembered, include *all* the land of these four classes, the woodland from twenty-five to thirty years' growth, that situated near large towns, railroad stations and other favored localities.

If we still further examine the census for cheap lands we find in several towns in the four western counties what we seek. Adding to the four classes last considered the pasture lands, we find in Becket 19,277 acres, valued at \$80,380, or \$4.12 per acre; in Florida 12,475 acres, valued at \$61,875, or \$4.96 per acre; in New Ashford 4,618 acres, valued at \$18,845, or \$4.08 per acre; in Otis 21,694 acres, valued at \$95,302, or \$4.39 per acre; in Peru 14,342 acres, valued at \$58,363, or \$4.07 per acre; in Savoy 18,509 acres, valued at \$65,837, or \$3.53 per acre; in Hawley 17,933 acres, valued at \$59,950, or \$3.34 per acre; in Rowe 10,580 acres, valued at \$44,077, or \$4.16 per acre; in Monroe 4,781 acres, valued at \$21,966, or \$4.59 per acre; in Granville 19,684 acres, valued at \$78,800, or \$4.00 per acre; in Tolland 13,736 acres, valued at \$56,440, or \$4.11 per acre; in Goshen 8,037 acres, valued at \$44,217, or \$5.50 per acre; in Pelham 14,245 acres, valued at \$79,321, or \$5.57 per acre; in Plainfield 11,313 acres, valued at \$47,400, or \$4.19 per acre; or in these fourteen towns

191,224 acres of land, valued at \$812,773, — an average of \$4.25 per acre.

These figures also include all the land in the several classes considered. It is well known to all who are at all familiar with the condition in the four western counties that there are thousands of acres recently cut over that can be bought for \$3 per acre, or even less.

The figures given above have been taken from the census, and, lest it may be thought that the values given are too low, I will refer to prices at which farms are offered by their owners in the "Catalogue of Farms in Massachusetts for sale at a low price," recently issued by the secretary of the Board of Agriculture. In that pamphlet are advertised 54 farms, containing 9,298 acres, for between \$7 and \$8 per acre; 5 farms, containing 875 acres, for between \$6 and \$7 per acre; 7 farms, containing 1,250 acres, for between \$5 and \$6 per acre; 6 farms, containing 1,940 acres, for between \$4 and \$5 per acre; 7 farms, containing 1,350 acres, for between \$3 and \$4 per acre; and 5 farms, containing 1,173 acres, for \$3 or less per acre. Most of these farms have buildings, fences, orchards and other improvements.

Since writing the above I have learned that a farm of 139 acres, formerly among the best in one of our most thriving hill towns, was during the past year sold for \$100. It was situated in a remote neighborhood; the buildings had disappeared, but all the cleared land was well fenced and used as a pasture, said to be a good pasture. The woodland was covered with a vigorous growth of various ages. The Oliver Smith Charities had held a mortgage of several hundred dollars on the property for several years, and had been obliged to foreclose. After long-continued effort to obtain a better price, the agent in charge accepted the offer of \$100 for the property, as the best he could get for it.

Several of the States of the Union have acquired lands for forestry experiment, and the matter is being generally urged by those interested in the perpetuation of the forests of the country. It was not the purpose of this paper to urge a definite plan, but to show the opportunity for and feasibility of State action. I have shown that there is an

abundance of cheap land suitable for forest-growth within the State. The State cannot do anything in the line of forestry without land to work upon. Provision might be made for a beginning by the purchase of lands offered for sale in lots of not less than a given number of acres, and at a price not exceeding a fixed limit. An official or board would be needed, whose duty would be to guard the interests of the State, making sure that no higher price was paid for lands than was necessary. This officer or board should have some latitude as to prices that might be paid, varying according to location and quality of land, condition of the forest growth, etc. The care of the land purchased would naturally devolve upon the same official or board, and methods for protection against fire and prevention of trespassing would be the first duty. The purchase of land would naturally begin with such as could be had at the lowest price, and only lands offered by the owners would be at first secured. Without doubt large areas would be offered at a low price. It would of course be necessary that some plan be adopted whereby the municipalities within which the lands purchased lay could be reimbursed for the loss of the annual taxes that had been realized from such land. It might be provided that the State should pay into the treasury of such municipality annually a sum equal to the amount of taxes levied on the land purchased in the year next preceding the purchase. If such a plan proved unsatisfactory, doubtless thoughtful men could work out a solution that would be just and reasonable. When plans for the improvement of the forests by scientific methods have been made, more latitude as to prices to be paid might be given, so that the tracts owned by the State might be increased to suitable size for most efficient improvement; but there is no question but land enough would be ready for a beginning in many localities.

What the financial result would be in after years can only be estimated. If the opinions of forestry experts are worthy of credence, and I believe they are, we must believe that with proper care and management these lands would furnish a large net revenue in years to come, proportionate to the

number of acres acquired by the State. It is a well-known fact that European countries receive large additions to their revenue from government forests. Sir Herbert Maxwell states, in the "Nineteenth Century" for October, that the government forests of Belgium, covering 1,740,000 acres, yield a return of \$20,000,000 annually.

THE INFLUENCE OF THE BOARD ON THE AGRICULTURE OF THE STATE.

BY MR. JOHN BURSLEY OF WEST BARNSTABLE.

As a half century of the work of this Board is now nearly completed, it is indeed a fitting question as to what has been the influence of the Board on the agriculture of the State. At the second meeting, held at the State House, Jan. 14, 1852, at which meeting a constitution and by-laws were adopted, it was —

Resolved, That, inasmuch as agriculture is the chief occupation of her citizens, the Commonwealth, in the organization of its government, should be provided with a department of agriculture, with offices commensurate with the importance of the duties to be discharged, of the abilities to be required and of the labors to be performed.

At this date, fifty years later, the agriculture of Massachusetts, while not holding its position as the chief occupation of our citizens, does employ, directly and indirectly, quite a large portion of our people.

The growing of the cereals and the raising of beef, pork and mutton, then the larger part of the work of our farmers, have all followed the advice of the late Horace Greeley, and “gone west.” With the westward march of these industries has also gone one of our best crops, viz., the plucky, brainy boys from our Massachusetts farms.

During all of this half-century the Massachusetts Board of Agriculture has not been idle. We hear it said occasionally that it is a sort of mutual admiration society, fostered for the good of its members, who are allowed two or three junket trips per year at the expense of the Commonwealth.

To refute that, those of you who have closely followed our work have only to bring to mind the years of careful, conscientious labor given so freely by a committee of this Board for the benefit of Massachusetts agriculture, and which labor would doubtless still be freely given had it not been refused by Massachusetts politicians.

Again, the care this Board has had over the annual fairs of the several agricultural societies has had a tendency to make these autumn exhibitions in a measure instructive as well as entertaining; and, though the conditions under which they are held have greatly changed during the fifty or more years of their existence, still in certain localities agricultural fairs, as to-day conducted, are nearly as upbuilding to agriculture and to the farmer and his family as they were when first organized.

The collection of statistics concerning the agricultural work of the State and the distribution of the same as performed by this office have afforded much information, of which farmers have availed themselves. The following letter explains how early this work was commenced:—

DEAR SIR:—I propose to send a circular letter to every town in the Commonwealth, for the purpose of obtaining statistics which will enable me to make an accurate statement of the present condition of our agriculture. If one of these circulars falls into your hands, you will greatly oblige me by answering the inquiries contained in it to the best of your judgment and ability.

Some of the questions may be more accurately answered by a reference to the books of the assessors, or by inquiry and conversation with intelligent men, in the vicinity, who have ample means of knowing.

I trust your interest in agriculture will dispose you cordially to co-operate with me for its improvement.

Very respectfully,

CHARLES LOUIS FLINT,

Secretary of the Board of Agriculture.

Boston, June 1, 1853.

Our public winter meetings held each year since 1863 have also been a great factor for the good of the agriculturist. At these meetings no pains or expense have been spared to secure the best talent the country affords,

and the hints and suggestions obtained have incited a thirst for more information in the minds of the people of many a rural Massachusetts village.

Well do I remember the first public winter meeting of this Board that I attended, held at Bridgewater, in 1881, and of the lasting impressions received from the presentation of a paper on the growing and feeding of forage crops, by A. W. Cheever, Esq., of the New England Farmer's editorial staff; also one on the management of mowing lands, by the late Capt. J. B. Moore of Concord. Our honored chemist, Dr. C. A. Goessmann, was present and participated in the discussion; and from him at that time I first learned of the fertilizing value of potash for our crops, as obtained from the muriate of potash of commerce. Only last week I met a Worcester County gentleman (not now a farmer) who told me of attending some of these winter meetings fifteen to twenty years ago, and of the information concerning agricultural work he obtained from the lectures.

Another and possibly greater factor for good has been the institute work, as ordered by the Board and directed from this office. At some of these institutes may be found nearly all of those who avail themselves of the privileges of our public winter meetings, as well as a much larger number who from force of circumstances are unable to attend the larger annual meeting. The speakers many of them are well trained for the work, and I can best illustrate the influence they exert by quoting the following words from a shrewd farmer friend of mine, whose head is whitened by the frosts of eighty winters. After listening to the talk of one of Massachusetts' brightest institute workers, he made this comment: "The speaker was a good one, who could make you believe what he said, even if you didn't want to believe it."

It was my privilege to attend and help direct an institute in a portion of our county, somewhat remote from my home, the speaker being the late J. A. Tillinghast of the Rhode Island Experiment Station, and to receive a few days later several communications asking for the address of Mr. Tillinghast, or for more information concerning the Rhode

Island poultry course. I was then more firmly convinced than ever that the work of this Board was influencing even our plain little Cape Cod farmers.

I personally never attend these meetings without returning home with an increased desire to be a better farmer than I had been before. The educational feature of these meetings should not be overlooked; for that which we acquire, which enables us to get more out of our lives as farmers, and creates within us the desire to use the ability of which we are possessed, is surely an influence for good.

Take the early reports of this Board, published nearly fifty years ago, and compare them with the reports published during the last decade, note for a moment the changes in the subject matter, and compare the statements of farm experiments as then conducted with the work of our agricultural teachers of the present. These reports, so carefully edited by secretaries Charles L. Flint, John E. Russell, Wm. R. Sessions and James W. Stockwell, are strong evidence that the Board has an influence upon Massachusetts agriculture. I have in my library a complete file, from 1852 to 1900, and occasionally enjoy very much reading one of the earlier volumes, and comparing the agriculture of that date with the present.

While it is true that some of these reports may find their way to the waste basket, with pages uncut, it is also true that wide-awake farmers are each year inquiring if the edition is out, being anxious to secure a copy, that they may obtain some desired information from the same. It is equally true that these reports cannot be carefully read without exerting an influence for good upon the reader. Compare for a moment the good derived from the reading of these reports with the influence for good that is derived from United States free seed distribution.

And now, brother members, if I have proved to you that this Board has been an influence for good upon the agriculture of this grand old Commonwealth, let us be fully alive to the needs of an ever-advancing, ever-changing condition. We must carefully study the situation, and propose those changes for the benefit of our agricultural

classes that will be demanded sooner or later by our people ; in short, we should be so thoroughly alive to the needs of our rural people that we can offer from this office the changes required before they have felt obliged to ask for them themselves. I believe by so doing this Board will continue to exist and exert an influence for good in years to come, the value of which cannot be estimated.

REPORT OF DELEGATES TO THE FARMERS' NATIONAL CONGRESS.

SIoux FALLS, S. D., OCT. 1-4, 1901.

Hon. J. W. STOCKWELL, *Secretary, Massachusetts Board of Agriculture.*

SIR:—The delegates from Massachusetts in attendance were John G. Avery, H. P. Howland and Noah Sagendorf of Spencer, and R. G. F. Candage and Sallie C. Candage of Brookline.

The Congress convened in the auditorium at Sioux Falls, Oct. 1, 1901. The president, R. G. F. Candage, called the Congress to order at 2 o'clock P.M. Prayer was offered by Rev. J. N. Hutchinson of the Sioux Falls Presbyterian Church. Addresses of welcome were made by Lieutenant-Governor Snow on behalf of the State and Judge H. H. Keith and others on behalf of the city and people. Responses were made on behalf of the Congress by Hon. J. Sterling Morton of Nebraska and ex-president B. F. Clayton of Iowa.

The president read his annual address, which is included as an Appendix to this report. The following essays were read and discussed at this session of the Congress, viz.: "The State department of agriculture, its mission and organization," by Professor Hamilton of Pennsylvania; "What shall we do with our surplus products?" by F. B. Thurber of New York; "The Nicaragua canal: its importance to the farmers of the south and west," by Col. Harvie Jordan of Georgia; "The irrigation of the west," by Pres. J. W. Heston of South Dakota Agricultural College; "The truth about the oleomargarine business," by Chas. Y. Knight of Illinois. This speaker took the ground that the business from beginning to end is a fraud; fraudulent in its

marking and sale as butter; a fraud upon the public who buy it for butter and pay the price of butter for it, when its manufacture costs not more than two-thirds that of butter; fraudulent because it foists upon the market an inferior article as genuine, and the manufacturers enter into collusion with their agents for its sale in defiance of State laws. He further took the ground that its sale unrestricted should stop, and that the Congress of the United States should enact laws to compel manufacturers to mark it plainly as oleomargarine. After a free and full discussion of the merits of the question, a vote was taken which resulted nearly unanimously in favor of the position taken by the essayist.

Other essays were: "The homestead beautiful," by Dr. E. Benjamin Andrews, Chancellor University of Nebraska; "Rice culture," by J. B. Foley of Louisiana; "The present aspects of the sheep industry," by Hon. J. R. Dodge of New York; "The American girl," by Mrs. Bertha Dahl Laws of Minnesota; "Farm home life," by Hon. M. F. Greeley of South Dakota; "Forest trees: extant and petrified," by J. P. Brown of Indiana; "The need of proper recreation for farm laborers," by Professor Gregg of Minnesota.

The following resolutions were reported and adopted: endorsing the postmaster-general in defending the public interests and that of legitimate publications; urging Congress to make liberal appropriations for rivers and harbors; urging Congress to investigate the effect of ranchmen upon the ranges whose lands should be preserved from actual settlers; in favor of the Nicaragua canal; expressing horror at the recent assassination of President McKinley, and sympathy with his family; urging the Legislatures of States to enact laws tending to prevent such occurrences; that every State should pay more attention to the study and instruction of agriculture; against oleomargarine and similar products; endorsing reciprocity trade arrangements; and in favor of extending rural free delivery and of the parcels posts.

R. G. F. CANDAGE,

For the Massachusetts Delegates.

APPENDIX.

PRESIDENT'S ADDRESS.

BY R. G. F. CANDAGE OF MASSACHUSETTS.

Delegates to Farmers' National Congress, ladies and gentlemen: Agriculture, as well as architecture and the arts, rose in the east and spread to the west, and no more fitting place could be found than this young and thriving western State in which to hold the twenty-first annual meeting of this Congress.

South Dakota, one of the youngest sisters of the family Union of States, though but sparsely populated in proportion to its vast acreage, has nevertheless made such strides of advancement in the past decade, in agriculture and things that make for the comfort, happiness and prosperity of her people, that her older sisters do not fail to take note of the laurels she has won, and to rejoice with her in her achievements, and to cheer her onward in the promise she gives of still greater in the near future.

In that article of prime necessity to man, life-giving and life-sustaining wheat, — that article which furnishes one of the highest standards of comparisons in real worth, “good as wheat,” — South Dakota in 1900 produced 20,149,684 bushels and stood ninth in the roll of wheat-producing States, Kansas standing first. But in production, while Kansas still held first place, with fifty-six bushels and a fraction per capita, South Dakota, per capita, moved up the line to second place, with fifty bushels and a fraction engraved on her banners.

Egypt, Syria and the Orient no longer contain the granaries of the world, as was the case when the brethren of Joseph went down into the valley of the Nile to buy corn, which we call wheat. Egypt was then the America of the world, where the older and the newer races of man flowed into each other, as they now mingle in this land of ours. When Asiatic hordes moved into Europe, occupied and

planted it with bearded grasses, bearing seed like the corn of Egypt, Europe shook off the sleep of ages, to take her place for the amelioration and advancement of mankind from barbarism to civilization. Mauritania, the Moor country of Africa, then fed Rome, and Carthage as a Roman state was an important wheat-producing centre. But when Europe became wheat and grain producing, Rome declined and fell from her high estate as ruler of the world. Rome was a military power, not agricultural. She trained soldiers, and depended upon other lands to supply her armies, without which she became powerless.

Wheat and the cultivation of it invigorated man in its planting, reaping, threshing, and in its eating, so that he became hardy and strong, and superior in physical and mental endowment over his brethren who, with less effort, made their diet of roots, herbs and the natural fruits.

America now, as ancient Mauritania, Carthage and Gaul once did, gives to the world of her surplus abundance of wheat. The reaping machine, binder and thresher of our day wear iron crowns of more worth and service to humanity than those of the Lombards; and the kernels of wheat produced by their agencies rival drops of water of the oceans and sands upon their shores.

It is not a wonder that the ancients, as recorded in mythology, offered sacrifices to Ceres, the goddess of grain harvests, and that in the flight of their imagination she became a planetoid, symbolical of the small star grains sown to produce the harvest of the universe.

Ages, like grains of wheat when sown, repeat themselves. Pharaoh, under the guidance of his prime minister, that Hebrew Joseph of master mind, bought up all the wheat of Egypt and stored it against the day of short crops; and as a consequence he became master of the situation, which led to his and his people being the slave masters of Israel for a period of four hundred years.

The Emperor Julian, in the fourth century, A.D., at Antioch, was held responsible by his subjects for a poor harvest, high price of bread and monopoly of the grain market speculators. He, to quiet them, sold his grain, and

put a low price upon it by law. Those early Christians, like Christians and Israelites of our day, saw their opportunity to corner the market, and of which they took advantage. They bought up the emperor's wheat, ran up the price, but kept back their own for a higher rise. The emperor was wroth, and published their doings to the world, which was all he could do about it.

We are familiar with recent attempts in this country to imitate the ancients in trying to corner the wheat and corn markets; and on the day this paragraph was written I read in a paper published in an eastern city the following: "President McKinley, on account of the recent drought, has raised prices of corn and wheat, and ought to be held responsible for their high prices, and also of potatoes, which has banished that tuber from the tables of so many people except trust magnates and holders of fat government jobs." This is parallel to the complaint made against Julian, and is one of many that might be cited, and well illustrates the point, that, like wheat, human nature does not change by lapse of time or by transplanting to another continent.

It was the wheat fields east of the Blue Ridge, in Jersey, Pennsylvania, Maryland and Virginia, that gave sustenance to the patriotic revolutionary army under Washington, in the seven years' war of American independence; and it was much the same region that, eighty years later, fed the confederate army under Lee in its unsuccessful attempt to sever the Southern States from the Union.

Forty years have elapsed since the latter attempt, and in that time the wheat-producing centre has steadily advanced westward to newer and more fertile lands, and is now encircling South Dakota, which at the close of the rebellion was the abode of wild tribes, with few if any white settlers; and we wonder that forty years has made of it such a flourishing State.

Nor has the wheat culture and agricultural progress halted east of the Rocky Mountain divide, but its onward march has been over them and down their slopes to the Pacific Ocean, where their progress was stayed, like the armies of Alexander, for lack of more lands to conquer.

Indian corn, or a better name, maize, — for the word corn to European sight and hearing signifies wheat, — was well known, cultivated and in use as food by the natives of this continent long before Columbus set out upon his voyage which resulted in its discovery. Peruvians, Mexicans and the tribes that made their camps upon lands now within the borders of the United States, planted, harvested and used it for food, stimulating its production by the use of fertilizers. Humboldt, in his “Kosmos,” says that Peruvians, under the enlightened and progressive sway of the Incas, used guano obtained from the Chincha Islands as a fertilizer ; and the Puritans at Plymouth, Mass., were taught by the Indians the cultivation of their corn and the use of fish as a fertilizer for it. Not only was maize indigenous to this continent, but so were said to be potatoes, tobacco, tomatoes and various other products of the soil now in use, as well as fruits of various kinds, and fish and wild beasts of the chase, and land and water fowl.

The total production of corn in this country for the three years previous to this was, for 1898, 1,924,185,000 bushels ; for 1899, 2,078,144,000 bushels ; and for 1900, 2,105,-103,000 bushels. For the same years the production of wheat was 675,149,000, 547,304,000 and 552,230,000 respectively. The production of oats for the same periods was 730,907,000, 796,178,000 and 809,126,000 respectively. The average production of corn per acre was 24.3, 25.3 and 25.3. The average production of wheat per acre was 15.3, 12.3 and 12.3. The average production of oats per acre was 28.4, 30.2 and 29.6.

. Great Wheat-producing States, 1900.

| NAME. | Population. | Crop Acreage. | Bushels produced. |
|-----------------------|-------------|---------------|-------------------|
| Kansas, | 1,469,496 | 4,660,376 | 82,488,655 |
| Minnesota, | 1,751,395 | 4,905,643 | 51,509,252 |
| California, | 1,485,053 | 2,771,226 | 28,543,268 |
| Washington, | 517,672 | 1,067,943 | 25,096,661 |

Great Wheat-producing States, 1900 — Concluded.

| NAME. | Population. | Crop Acreage. | Bushels produced. |
|-----------------------|-------------|---------------|-------------------|
| Nebraska, | 1,068,901 | 2,066,825 | 24,801,900 |
| Texas, | 3,048,828 | 1,271,517 | 23,395,413 |
| Iowa, | 2,251,829 | 1,397,322 | 21,798,223 |
| Pennsylvania, | 6,301,365 | 1,502,321 | 20,281,334 |
| South Dakota, | 401,040 | 2,920,244 | 20,149,684 |
| Missouri, | 3,107,117 | 1,505,737 | 18,846,713 |
| Illinois, | 4,824,550 | 1,393,236 | 17,982,068 |
| Oregon, | 413,352 | 1,173,769 | 16,198,012 |
| North Dakota, | 319,040 | 2,689,023 | 13,176,213 |

Rice.

Rice, one of the valuable products of this country and of the world, the principal article of food of half the human race, known to the ancients, cultivated on marshy soil in warm latitudes, was introduced and cultivated in this country in Virginia, by Sir William Berkeley, in 1647. From a half bushel of seed he raised sixteen bushels.

The first obtained in South Carolina was obtained from a ship that put into Charleston, from the Island of Madagascar, in 1694. From that source, and possibly others, its production in 1698, four years later, had increased so that sixty tons were exported to England. Its culture in Louisiana was begun in 1718. As a paper will be read before this body on this subject, I shall defer further allusion to the subject until that time, except mention of a novel use of rice and old shoes at weddings, the significance of which is so well understood that comment thereon seems unnecessary.

There are other products of barley, rye, millet, buckwheat, beans, peas, sugar, honey, butter, vegetables and fruits, which form a part of the food of our people, and a profitable business to the farmer who cultivates them, of which time and space here do not permit a description.

The natives of America, at the time, and before its discovery by Europeans, supplied their need of flesh from the wild animals of the forest, of fish from streams, rivers, ponds, lakes and the sea, and of wild fowl from land and water. There seems to be need of more animal food to dwellers on this continent than is required by citizens of Europe, or, if the actual need does not exist, the consumption is much greater here than there. The wild game and fowls were decimated by the increase of settlers from over the sea and their descendants, and that supply could no longer meet the demand, and so domestic animals had to be introduced to supply that need and the requirements of a different civilization. Horned cattle were imported, as were sheep and swine, for food, for profit to those who kept and produced them and for the labor oxen could perform in clearing and cultivating lands. Horses and asses were also imported, not for food, but as aids in the development of the country, and for their valuable service in many ways.

The Scriptures teach that "Man shall not live by bread alone," however well it may be buttered, spread with honey or dipped in golden syrup extracted from the juices of sugar cane. Like the tribes of Israel wandering in the desert, though fed on heavenly manna, they still longed for the flesh-pots of Egypt, so Americans, better fed than any other people, are not content unless they possess an abundance of animal food.

And that subject leads to the consideration, in a cursory manner, of American food-contributing, domesticated animals. Horned cattle were not found on this continent by its European discoverers, but were imported into Hispaniola by Columbus, in 1493, and by the Spanish settlers to the main, from which the wild cattle of South America and of Mexico and Texas are said to have originated. The Portuguese brought cattle to Newfoundland in 1553; the French brought them from Normandy to Canada about 1601; the English brought a hundred head to Jamestown, Va., in 1611; and a bull and three heifers were brought to Massachusetts in 1624. From these and later importations have sprung the herds that find pasture and thrive in the United States, and the many millions that are found on this western

hemisphere, from the non-grass-producing latitude on the north to the pampas of Patagonia and the boundaries of the Magellan Straits on the south.

The cattle industry of the United States alone is of gigantic proportions and of immense value. In the year 1900, after supplying the home demand there were exported 397,286 head of live cattle, valued at \$30,623,153, meats valued at \$42,170,470 and dairy products of \$9,226,520, — a grand total of \$82,020,080. It is estimated that more than twenty per cent of the herds are yearly slaughtered in filling this great and increasing demand for beef food.

Sheep.

No domestic sheep were found in America by the early discoverers. They were first introduced into Virginia from England in 1609, where, forty years after, they had increased to 3,000; into Massachusetts and New England in 1625; Spanish merinos were brought to Boston in 1793, and French merinos were introduced to this country in 1846. From these sources, with occasional small additions, sprang the flocks of American sheep husbandry. At this writing it is stated that Vermont merino rams of the best type are worth, for breeders in Australia, \$2,000 each; and one breeder refused an offer for one such of \$5,000.

In the year 1900, in addition to the home demands, there were exported 125,772 head, valued at \$733,477. Forty per cent of the flocks are said to be slaughtered yearly for food. As there is to be a paper read before the Congress on sheep husbandry, I defer further remarks at this time.

Swine.

The hog, well known to and held in high esteem by the ancients, was the animal devoted to be sacrificed to Ceres, the goddess of harvests. He is not native to this country, but was brought to Hispaniola by Columbus in 1493, to Florida by De Soto in 1538, to Newfoundland in 1553, to Canada in 1608 and to Virginia in 1609. In the latter they are said to have multiplied so rapidly that the settlers were obliged to fence Jamestown in to keep the hogs out.

The number exported in 1900 was 51,180, valued, with other hog products, at \$112,861,490. Fifty per cent of the number of swine are annually slaughtered in the United States. Hogs, sheep and horned cattle produce the bulk of all animal food consumed in our country. Swine's flesh, so extensively used as food by Christians, Chinese, Japanese, South Sea Islanders and others, is not eaten by Hebrews, Mohammedans and Hindoos, it being considered by them unclean.

Horses.

The horse, though not to any extent a food animal, is the most useful of all animals to man as a servant upon the farm; in peace and in war he is the indispensable, intelligent friend of man and bearer of his burdens. He who does not admire and love that noble animal must be lacking in those noble qualities—appreciation of worth, love of family ties, kindred, country and home—which raise man above the level of the lower brutes.

The horse, according to an ancient fable, was created by Neptune as an animal most useful to man and of the greatest value to him and to his race. History does not record his original native country, but does state that he was brought under subjection to man in central Asia and in northern Africa, adjacent to Numidia, and Abyssinia. He was not native to this hemisphere at the time of its discovery, although fossil evidence is found that in geologic and prehistoric time he was an inhabitant. He was imported by early discoverers and settlers from over sea, and in time his progeny spread over the pampas of South America and the plains of Mexico, Texas and the pastures of the north.

Great care and pains have been taken to improve the breed, until to-day no country produces better or more valuable horses than the United States. Notwithstanding steam machinery in town and country, and steam railways, electric railways and automobiles which have taken the place of horses, they are still in demand and of value, and will doubtless continue an important adjunct of agricultural interests. Large sums have been invested in them, the

magnitude of which can be imperfectly summarized by the statement that in the year 1900 there were exported 64,722, valued at \$7,612,616.

There are many other great agricultural interests of our country to which your attention might with profit be called, but it is not the purpose of an address of this nature, either in outline or in allusion, to attempt to exhaust them. Those called to your attention are simply suggestive of consideration and study by him who, having time, opportunity and the desire to know more of them, may seek further information in the direction to which they may lead.

There is one subject, however, to which I shall call your attention, which ought not to be omitted here, it being, in magnitude, value and importance, not only an agricultural product rivalling many another, but is so linked with our daily life as to be almost indispensable, and that is, cotton.

Cotton.

One of the greatest and most valuable crops of our country was first mentioned by the historian Herodotus about 450 B. C., who relates that trees in India bear, as fruit, fleeces more delicate and beautiful than those of sheep, which the people of that distant land manufacture into cloth. Aristobulus and Nearchus, generals of Alexander, brought to Greece accounts of the cotton tree and its product, and Theophrastus also described its culture and use. From India cotton was brought to Rome, and before the Christian era Verres in Sicily used it for tent coverings. Caesar covered the forum with awnings made of cotton, and also the sacred way from his house to the Capitoline hill, which was a great wonder to the populace.

In America the product and manufacture of cotton was well understood by Peruvians and Mexicans long before Europeans had discovered and set foot upon the continent.

Columbus found the cotton plant in Hispaniola; others found it as far north as the Mississippi and its tributaries. Cortes, on setting out from Trinidad de Cuba for the conquest of Mexico, quilted the jackets of his soldiers with it, as a protection against Indian arrows, after the manner of

the natives. In Mexico, among the presents he received from Montezuma were "curtains, coverlets and robes of cotton, fine as silk, of rich and various dyes, interwoven with feather-work that rivalled the delicacy of painting."

In the United States cotton was first planted in 1621, "and its plentiful coming up," says Purchas's Pilgrims, "was a subject of interest in America and England." The first shipment from this country noted was from Charleston, S. C., to England, in 1748, consisting of seven bags, valued at £3, 15s. 5d. per bag. From that small beginning the product in 1900 was 9,137,000 bales, of which there were exported 6,090,144 bales, of 3,100,583 pounds, valued at \$242,988,978.

Its manufacture has kept pace with its production, until at this time it enters into almost every article of clothing, the fittings and furnishing of every dwelling, carriages, railway cars, steamship and sailing craft. In gun cotton it furnishes an agent destructive to life and limb, and in hospitals it furnishes bandages and articles of comfort and healing for wounds it has caused, and winding sheets for those slain, through its agency. It is often the cause of destructive fires and conflagrations, which are kept under control or extinguished by water passing through hose composed wholly or in part of cotton. And in many other ways has cotton contributed to the welfare, comfort and health of mankind. How should we get along without it? Great, important and of untold value is the cotton crop of America and the world, of which our land produces the major part.

There are now forty-five States in the Union, while at the adoption of the federal constitution there were but thirteen. Nineteen of the forty-five have since been added from territory acquired by cession, purchase or the spoils of war. And we yet have territory from which other States will be formed in due time, and which do not include Alaska, Hawaii, Porto Rico, the Philippines and other minor island possessions.

This vast area, with its nearly eighty millions of active and stirring people, produces more than enough for the

needs of that mighty host from its cultivated acres, and had a surplus of the products of the farm, factory, forest, shop and mine, in 1900, valued at nearly a billion and a half of dollars, which it shipped to other countries to supply their deficiencies. Though drought and other causes may have reduced somewhat the yield of certain crops in the year 1901, there can be no fear of a shortage in the food products of our land, which, with its great extent, diversity of climate, soil and products, render it sure that "seed time and harvest shall not fail."

The general prosperity of our country is a matter of congratulation, and its rapid strides in the past decade in population, wealth and things that make for a nation's greatness is a surprise to us, and a wonder to the other nations of the world.

But it is not for me to do more than to call your attention to certain matters, any of which could be elaborated into a paper to be placed on the programme, but simply to suggest leaving argument and discussion to the members of this Congress, to deal with them according to their pleasure. Nor can it be attempted to even suggest, in an address of this nature, all the subjects that pertain to agriculture or that are linked therewith. The order of procedure for this Congress has been arranged in accordance with a printed programme, to which your attention is directed; and it is to be hoped that it will not only be acceptable, but enjoyable and instructive.

One of the chief influences that the Farmers' National Congress exerts emanates from the resolutions it passes. It is the privilege of any delegate to offer a resolution and have it referred to the regular committee for its approval or disapproval, and then be reported back to this body for final action. Such resolutions should be national in their scope, bearing and application, and not local or sectional, and should be characterized by principle embodied with wisdom.

The time allotted to this Congress in which to hold its meetings for the performance of its duties of deliberation,

discussion and passage of resolutions, is limited by the desire, expediency and wish of its delegates, who voluntarily attend it, in many instances performing long journeys and bearing their own expenses. Therefore it is of importance that its business be as expeditiously and wisely conducted, in harmony and good fellowship, as can be expected of any great national organization.

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THREE COMMON ORCHARD SCALES.

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Our knowledge of scale insects has been very limited until recently. The injuries they cause have passed unnoticed in most cases, while the occasional loss of some tree has too often been attributed to some other cause. The appearance of the San José scale in Massachusetts, however, and its rapid extension over the State, followed everywhere by serious injury to the trees attacked, has attracted much attention to this group of insects.

Although over a hundred different kinds of scale insects probably occur in Massachusetts, only three are likely to be present in any orchard in sufficient abundance to cause injury to the trees and demand attention, and only one of these is usually so destructive as to require radical measures for its control. These three are the oyster-shell scale, the scurfy scale and the San José scale. It is important that every person having fruit trees should learn to recognize these three scales, and know what treatment to apply for each if he wishes to obtain his crops, or, in case of the San José scale, if he wishes even to keep his trees alive.

THE OYSTER-SHELL SCALE.

(*Mytilaspis pomorum* Bouché.)

This scale is a native of Europe, and reached this country, where it is now generally distributed, about a hundred years ago. It is probably present in every orchard in Massachusetts in greater or less numbers, and is also abundant on many of our shade and forest trees.

During the winter the scales of this insect are very noticeable on the twigs and smaller branches of many trees, often

completely covering them. The scale is about one-eighth of an inch long, quite pointed at one end, rounded at the other, and usually somewhat curved to one side (Fig. 1), so that in general outline it somewhat resembles an oyster shell. Its color is dark reddish or grayish brown. If one of these scales be lifted, and its under side examined under a microscope, from twenty to a hundred whitish or yellowish eggs will be found, while under the pointed end are the remains of the parent insect which produced the scale.

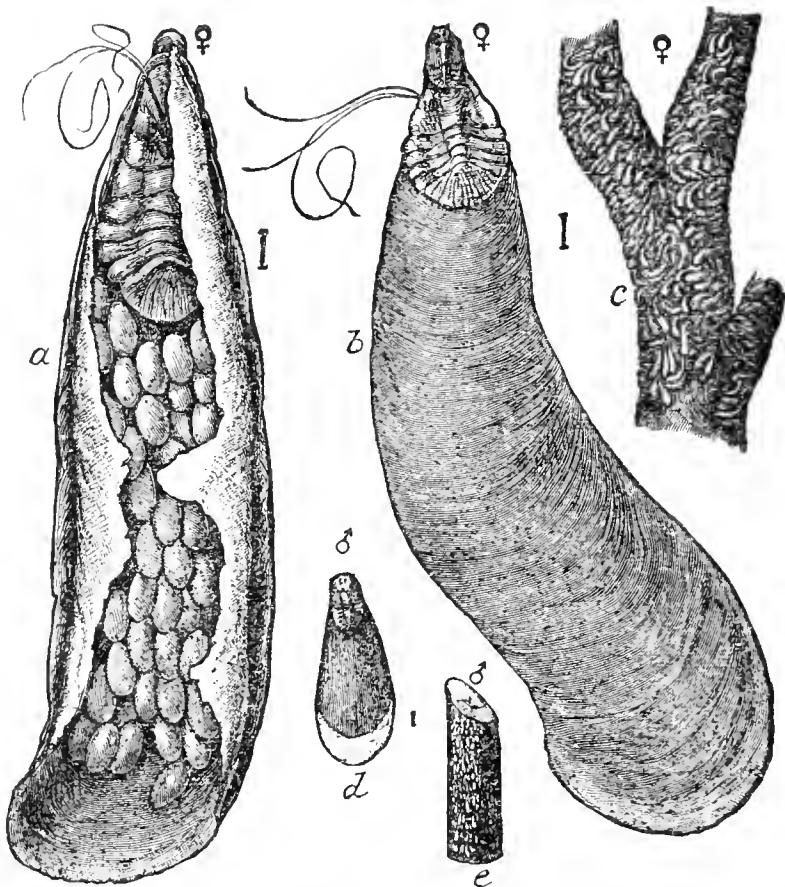


FIG. 1. — Oyster-shell scale: *a*, under side of female scale, showing eggs; *b*, upper side of same, both much enlarged; *c*, female scales on a branch, natural size; *d*, male scale, much enlarged; *e*, male scales on branch, natural size. The fine lines to the right of *a*, *b* and *d* show the real length of the scales. (Howard, U. S. Dept. Agr., Yearbook, 1894.)

The eggs hatch in Massachusetts about the 10th of June, the exact time varying with the nature of the season, and the little yellowish young escape from under the scale and crawl about over the twigs, seeking for places to locate. After a few days they settle down, push their sharp beaks through the bark and begin to suck the sap from the tree. Here they remain, and gradually cover themselves with

scales as a protection. In the fall the eggs are laid under the hinder part of the scale, and the parent dies, leaving its scale as a covering during the winter for its eggs, which hatch the following spring. The male scales are smaller and of a slightly different form from the female scales, as shown in Fig. 1.

This insect is found on a large number of food plants, the more important ones being the apple, pear, plum, quince, lilac, ash, poplar, willow, elm, maple, raspberry, currant and rose.

THE SCURFY SCALE.

(*Chionaspis furfura* Fitch.)

The scurfy scale, probably a native of this country, is generally abundant over the eastern United States, but is most plentiful south of New England.

The scale itself is somewhat smaller than that of the oyster-shell scale, and is usually broader in proportion to its length. One end is somewhat pointed, while the other is irregularly rounded, the general color being a dirty white, which makes it quite noticeable (Fig. 2, *a* and *c*).

The scales of the male (Fig. 2, *b* and *d*) differ from those of the female above described in form, and are also smaller.

The habits of this scale are similar to those of the oyster-shell scale, the winter being passed in the egg stage. The ten to seventy-five eggs which may be found under the female scale hatch in June, and the purplish young crawl about for a few days, after which they settle down to feed. The remainder of the life history is much the same as that of the oyster-shell scale.

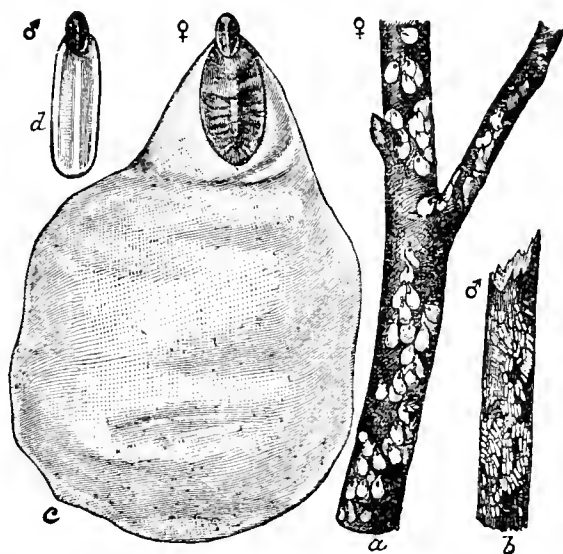


FIG. 2. — Scurfy scale: *a*, female, *b*, male scales, natural size on twigs; *c*, female scale, much enlarged; *d*, male scale, much enlarged. (Howard, U. S. Dept. Agr., Yearbook, 1894.)

The scurfy scale is found on the apple, crab-apple, pear, peach, cherry, quince, Japan quince, currant, mountain ash and many other plants.

Treatment for the Oyster-shell and Scurfy Scales.

The treatment for these two scales is comparatively simple. As there is but one brood of young each year, the infested trees or plants should be sprayed soon after the young hatch from the egg; this will be some time in June, varying with the season. The material used for spraying may be either kerosene emulsion or a mechanical mixture of kerosene and water. If kerosene emulsion be used, it should be prepared as follows: hard soap, shaved fine, one-half pound; water, one gallon; kerosene, two gallons. Dissolve the soap in the water, which should be boiling; then remove from the fire, and while hot pour it into the kerosene. Churn this with a spray pump till it changes, first into a creamy, then into a soft, butter-like mass. For use, take one part of this prepared emulsion and thoroughly mix with nine parts of soft water by churning it back into the pail, or whatever it may be in, through the spray pump until it is thoroughly mixed, then apply to the tree. This treatment in ordinary seasons should be made about the 15th of June, and a second one ten days or two weeks later.

If the mechanical mixture be used instead, a special pump, having two tanks, such as the "Kerowater," should be used, the pump being adjusted so as to mix five per cent of the kerosene with ninety-five per cent of water. The time of the treatments should be the same as when kerosene emulsion is used.

THE SAN JOSÉ SCALE.

(*Aspidiotus perniciosus* Comst.)

This most serious of scale insects was first discovered in this country in California, about 1870. It is probable that Japan is its native home, as it has several times been received from there on imported stock. In 1893 it appeared in Virginia, where it seems to have been received from New

Jersey. An investigation in the latter State led to the discovery that two nurseries there had about the year 1886 or 1887 introduced the "Kelsey" plum from California, in the hope that it might be proof against the attacks of the curculio. The trees thus obtained did not thrive (probably because they were infested by this scale), and were ultimately destroyed, but presumably not until the insect had spread from them to other nursery stock. As both of these nurseries did a large business, the scale was in this way scattered all over the eastern and middle States before the danger was realized. As many of the places to which the infested stock was sent were nurseries, these in turn became infested, with the result that the San José scale is now present in nearly every one of the United States, as well as in Canada and other foreign countries.

Life History.

The insect passes the winter under the scale, but it is probable that both the adult and the very young insects die during this period. In the spring those which are alive resume their feeding and become full grown about the first or middle of June. The production of young soon follows, these being born alive. When the young first appear they are extremely minute, yellowish in color, and with six legs. They crawl away from the parent scale and move about for a day or two, then settle down, and, inserting their beaks into the bark, begin to suck the sap from the tree. About this time little waxy threads develop on the surface of the body, and soon fuse together to form the first portion of the covering scale. When this is completed, the scale is white, nearly circular in outline, and with a little hump or nipple in the centre. About ten days later the insect molts its outer shell and adds this to the covering scale, which by this time has become dark gray, except the central nipple, which is lighter colored, often yellow. About ten days later the female insect molts again, and, as before, adds the molted skin to the covering scale, thus making it larger than those of the males, which do not undergo a second molt.

Soon after molting the second time the females become

mature and begin to produce young, "averaging ten a day for more than a month." Each of these young develops as just described for the parent, and those produced first have begun to produce young in their turn before their parent has completed the same process.

As a result, young, crawling forms may be found at almost all times from the last of June until frosts appear in the fall, during which time it has been calculated that the progeny of a single female may number 1,608,040,200, all of which have obtained their nourishment from the plant they are on. With a power of increase as rapid as this, it is not strange that trees suffer severely and often die in a short time after being attacked by this pest.

Food Plants.

The San José scale feeds upon nearly all our plants, shrubs and trees, except evergreens. Its more usual food plants, however, appear to be the pear, peach, plum, cherry, strawberry, raspberry, blackberry, gooseberry, currant, grape, rose, osage orange, elm, maple, chestnut, oak, birch, willow and Japanese plants. It attacks trunk, branches, twigs, leaves, and even the fruit: and during the year 1900, currants, pears and apples, grown in Massachusetts, were received so covered by these insects as to render them unsalable.

Distribution in Massachusetts.

This scale was first discovered in Massachusetts in 1895. Since that time it has appeared in a large number of places in the State, probably introduced on stock purchased from infested nurseries, and it is now known to occur in the following places: Amherst, Attleborough Falls, Auburndale, Bedford, Belchertown, Beverly, Billerica, Boston, Brookline, Danvers, Dighton, Dracut, Everett, Greenwood, Groveland, Holyoke, Jamaica Plain, Leominster, Lunenburg, Malden, Middleborough, Millville, Natick, Newtonville, North Abington, North Attleborough, North Cambridge, Norwood Central, Reading, Revere, Roslindale, Russell, Salem, Saxonville, Scituate, Somerville, South Framingham, South Chelmsford, Swampscott, Taunton, Three Rivers,

Townsend, Winchester and Worcester. It is probable that in addition to these forty-four places it is present in as many more, existing unrecognized and perhaps unnoticed.*

How the Scale spreads.

The most important way in which the scale spreads is, as has already been shown, by its conveyance upon nursery stock. Its spread from tree to tree, however, occurs by means of the crawling young. These are very small, and may easily be blown off the tree they are on by sudden gusts of wind, and, if carried to another tree, or even very near it, may be able to establish themselves. Others crawl onto the feet of birds or even other insects as these rest on infested trees, and when they fly to other trees may crawl off there. If the branches of adjacent trees touch, the young may crawl directly from one to another.

Enemies.

The San José scale is not without its enemies, which prey upon it. Chief among these are the lady-birds, or lady-bugs, as they are commonly called, perhaps the most common one which feeds upon the scale being the "Twice-stabbed lady-bug," which is a small, shining black beetle, about an eighth of an inch long and nearly as wide, with its upper surface very strongly convex, and with two dark-red or orange spots on the back. This insect is of much aid in the destruction of the scale, but unfortunately its rate of increase is so much less than that of the scale that it is unable to do more than somewhat reduce the numbers of the pest.

There are several parasites of the scale, as well; but here, too, their rate of increase is less rapid than that of the scale, which of course renders their work of less value than would otherwise be the case.

A fungus occurs in the southern States which also attacks the scale, and this has been cultivated somewhat, in the hope that it might be made use of in controlling the insect.

* April, 1902, over 60 places are now known to be infested.

Thus far, however, these hopes have failed to be realized. In fact, all of these enemies together fail to do more than to somewhat check the rapid increase of the scale, which, when present, requires treatment by man in addition, if the infested plants are to be kept from entire destruction.

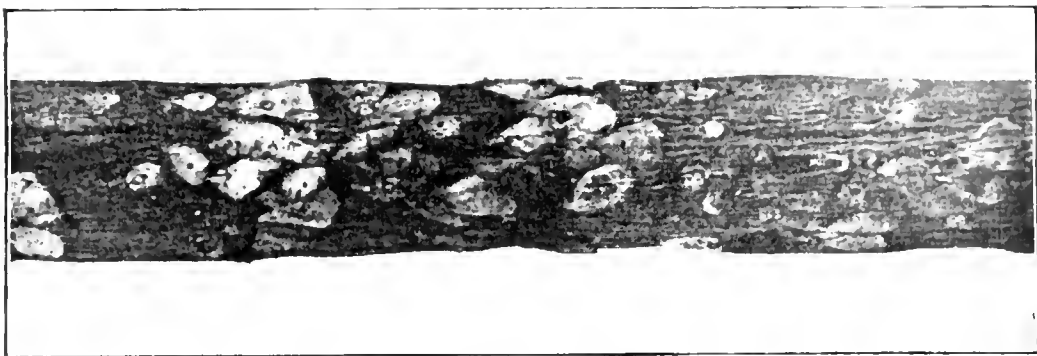
Treatment.

The methods of treatment for the San José scale successfully used on the Pacific coast have thus far failed in the eastern United States, where they are “fatal to only a small percentage of scales.” Why this is the case it is difficult to say. In California the treatment is applied some little time before the rainy season, which gives an opportunity for its action before being washed off by the rains. In the east, however, this treatment must be applied at times when rains are frequent, and it may be that in this fact is found the reason why the treatment is a failure in this part of the country.

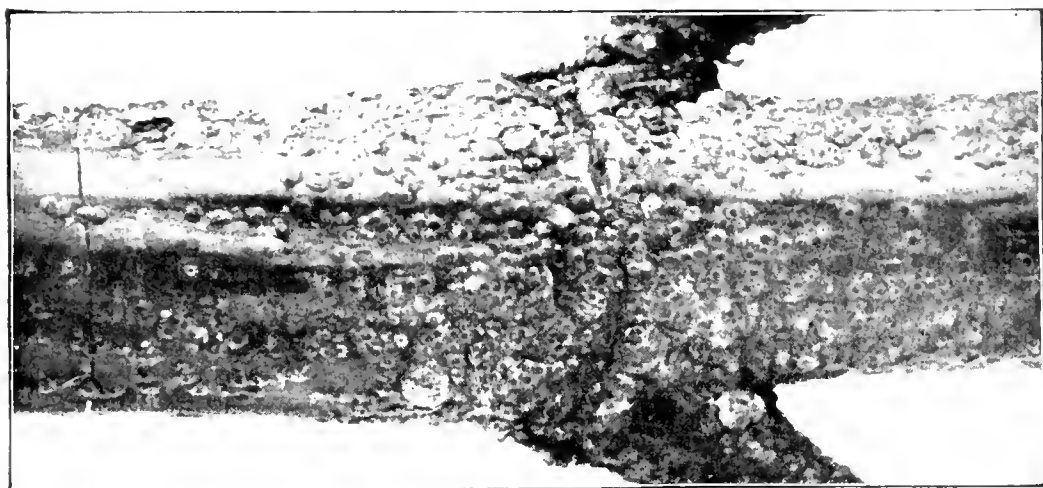
The San José scale is a sucking insect; consequently, neither Paris green, arsenate of lead or any of the so-called “stomach poisons” are of the slightest use. The treatment which will kill it must be something which kills by coming in contact with it; and as the insect, except in its earliest stages, is covered by a hard scale, the treatment must be by the application of some substance caustic enough to eat or corrode the scale and penetrate to the body of the insect beneath. Spraying with kerosene emulsion will kill the young insects, of course; but as these appear every few days from some time in June until November, or even December in some cases, this would mean that the infested trees must be sprayed at least once a week during this entire time, which is also the time during which it is most difficult to reach all parts of the tree thoroughly, on account of the foliage. Accordingly, treatment during the winter months is the best.

Destruction of Trees infested.

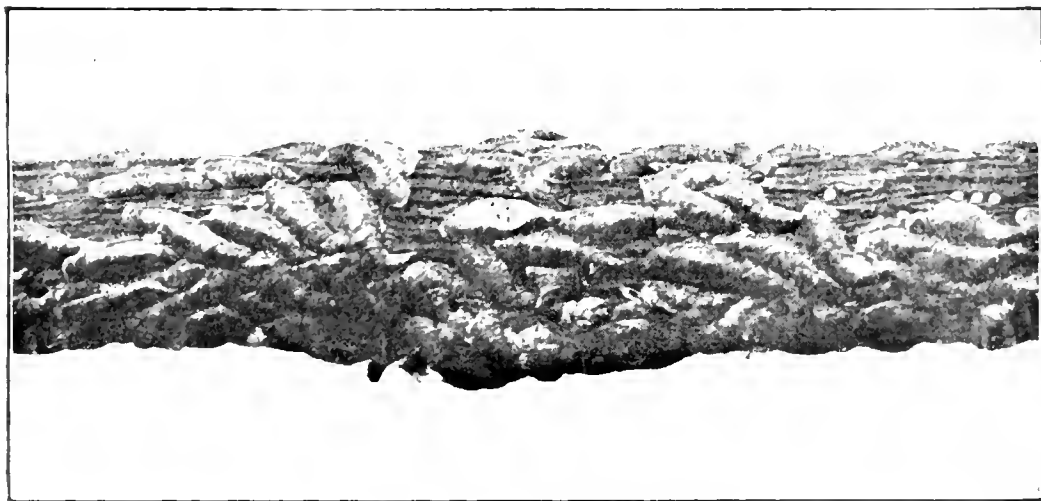
In cases where the scale has just appeared, or but few trees are infested, the cheapest and safest treatment is to cut down and burn those trees. If a tree be thoroughly covered



The Scurfy Scale.



The San José Scale.



The Oyster-shell Scale.

THREE COMMON ORCHARD SCALES.—Twice Natural Size.

with the scale, burning is also the best treatment, as it will be almost impossible to clear such a tree sufficiently to make it valuable for its product, while it would be a constant menace to all other trees around. The sooner a badly infested tree is destroyed the better.

Kerosene.

During the winter months, while the trees are not growing, much stronger materials can be used for treatment than during the growing season. This is particularly the case between the first of January and the time when the buds begin to swell. During this period pure kerosene may be used under certain conditions with success. Kerosene will kill every scale which it touches, but, unless used in experienced hands, it is likely to kill the tree also, even during the late winter months, hence should be used with caution, and, as there are other and safer treatments, its use in general should be avoided. If it is desired to try it, however, the following suggestions should be closely followed : —

1. Use pure kerosene in January, February or March only.
2. Use the finest nozzle to the spray pump which can be obtained.
3. Stop spraying any portion as soon as it is wet.
4. Spray on a bright day, when a slight (not strong) breeze is blowing.

Crude Petroleum.

This substance has been recommended as an insecticide for scale insects by Dr. J. B. Smith of New Jersey, where it was first tried in 1898. While perhaps not beyond the experimental stage as yet, it seems to promise well if precautions be followed in its use. Some of the conclusions drawn from experiments with it are : —

1. Treatment should be made in January, February or March.
2. Crude petroleum is not adapted to summer use.
3. It kills the scales wherever it comes in contact with them.
4. It may be used pure, but a more even distribution is obtained by mixing forty parts with sixty of water by means

of a two-tank pump, such as the "Kerowater." Do not apply too much.

5. Use a very fine nozzle.

6. Spray on a reasonably calm day, when the trees are dry.

7. Use petroleum testing 43° Beaumé or above at 60° F. Petroleum testing lower than 43° at this temperature is dangerous to the trees.

In this last statement lies one of the chief difficulties. Crude petroleum is a very variable substance, and, if it be of too low a degree of the Beaumé scale, it is likely to injure the trees.

Fumigation.

While fumigation is the most certain method of destroying the scale, its use is not usually practicable by fruit growers in this State. Gas-tight tents, large enough to completely cover the trees, are necessary, and are expensive. The gas generated is a very dangerous one, and its use can hardly be recommended to one not familiar with it. It should be used for the treatment of nursery stock before shipment, however, and so many nurseries in this country now have the scale that it is desirable that only fumigated stock be purchased.

Whale-oil Soap.

This is usually a fish-oil rather than a whale-oil soap. It should be liquid when cold even in as strong a mixture as two pounds to a gallon of water. If it contains fats other than the fish oil, it is likely to prove unsatisfactory, and it should therefore be obtained from a reliable manufacturer.

This soap should be dissolved in water at the rate of two pounds of soap to a gallon of water, by heat, and sprayed between the first of January and the time the buds open. If it is desirable to spray in the fall, this may be done after the leaves have fallen, using one pound to a gallon of water.

Treatment with whale-oil soap is probably the most practical for fruit growers to make use of in most cases.

Summary of Treatment.

1. Fumigation is the most effectual treatment known, but must be given under such conditions as to make it usually impracticable for general use by inexperienced persons.

2. Kerosene will kill the scale, and is likely to kill the trees as well. A strength of kerosene and water mixture which will not injure one kind of tree may kill another kind.

3. Crude petroleum may prove the best remedy to use, but must test above 43° Beaumé, and be used only in January, February or March.

4. The treatment recommended for general use, except in nurseries, is as follows : —

(a) Spray infested trees with whale-oil soap, two pounds to a gallon of water, before the buds start in the spring, or at the rate of one pound to a gallon of water, after the leaves are off in the fall.

(b) Cut back and prune infested trees before spraying, burning the prunings.

(c) Cover as much of the trunk and limbs with white-wash, about the first of June, as the tree will safely stand.

(d) Badly infested trees can probably never be entirely cleared, and, if left, will distribute the scale to all trees near by. Cut and burn all badly infested trees.

(e) In spraying for the scale, remember that, to be destroyed, each scale must be touched. Use a very fine nozzle, and try to reach every part of the tree, but stop spraying any part before it begins to drip.

5. Never purchase stock not accompanied by a certificate of inspection, signed by an authorized inspector, or by a guarantee that it has been fumigated with hydrocyanic acid gas. One who neglects this has only himself to blame if his trees prove later to have been infested.

A LESSON IN ECONOMICS: WHAT THE AGRICULTURE OF THE TWENTIETH CENTURY DEMANDS.

BY DR. G. M. TWITCHELL, EDITOR "MAINE FARMER," AUGUSTA, ME.

The consideration of the question of economics imposes obligations on the writer or speaker not to be neglected, else failure is sure to result. It is easy to cry out against recognized practices, and, viewing the situation from the outside, bearing none of the weight of responsibility, criticize existing conditions and standards. At the same time, standing on the inside, conscious of the difficulties confronting, there is grave danger that established practices and habits may blind to the importance of open-eyed vision, of being watchful of all changes and prepared to adjust when good business suggests, or reconstruct when by reconstruction more is to be obtained. The fundamentals of all business remain the same; it is the adjustments which time is constantly modifying, and wise is he whose finger is on the pulse of trade to feel the variations and note intelligently their significance.

Agriculture forms no exception to the rule, and here, perhaps, is the lesson most difficult to learn. Life on the farm, the very conditions attending operations there, leads to deliberate action. One cannot thrust into the business the restless energy possible on State Street, Boston, and this deliberation may act as a barrier to the adjustment of methods and practices which the changing conditions of business first suggest and afterward render imperative.

Economy as applied to an industry must have a wide significance. It necessitates not only the completest elimination of waste, both in time, material and labor; it requires not only the readjustments of methods and products, with the sole thought of leading, not following, the market, but

it imposes upon the manufacturer that watchfulness of events, that study of tastes and that constant contact, mental and physical, with moving currents, which alone can insure against loss.

The application is universal. The ruts of habit do not lead along the highway of progress. Large men, with vision sharpened by friction with the bustling activities of this new century, are as necessary on the farm as elsewhere. So much more is involved than simply to plow, plant, sow and harvest, that the subject must be debated on a broader plane. It is easier to grow a crop or make a product than it is to realize the most from it in the market; yet every principle of economy demands that not only shall all waste in growing or manufacturing be prevented, but that there be no loss in disposing of what is produced.

He who faces agricultural problems in these days, when competition is growing sharper, and ever-widening areas are filling our markets with the products of the land, must realize the complexity of the situation. The necessity for maintaining the agriculture of New England was never greater than at the present hour, and, rightly considered, the outlook improves in spite of the difficulties to be mentioned. At the same time the producer cannot hope for higher prices to rule, and therefore must study the field to ascertain, if possible, whether or not there is opportunity to reduce cost of production, improve quality, hasten maturity or increase quantity per head or per acre.

The farm producer is not exempt from the general law of business, which imposes these same obligations on every one who would succeed. If, then, it be true that the principles of business govern here, as elsewhere, the question may well be considered from a purely business stand-point.

How reduce cost of production? For the past quarter of a century this has been the query facing the manufacturer in every department of labor. That it might be compassed, the inventive genius of the age has been searching, with fine mathematical adjustments, that construction of machinery which might reduce friction, do away with hand labor and increase product. The results attest the skill of the

mechanic and the genius of the inventor. The farmer is to-day a manufacturer, in that the controlling conditions impose artificial relations and restrictions.

No man has yet compassed the capacity of machinery; no one realizes the power of nature to respond to an intelligent invitation. The milk maker who cannot tell what the product is per year for each individual cow is suffering from a loss of surprising magnitude, even though the average of the herd is above the cost limit. We make superficial selections. A heavy flow when fresh is too often accepted as evidence of value, and three or four months' idleness at the end of the year is overlooked. In the majority of herds of twelve, where individual daily records are not kept, the loss caused by non-profitable cows may easily be reckoned at twenty-five per cent; that is, the range of production is so wide, that, unless closely watched, one-quarter of the herd becomes a burden upon the pocket-book of the owner by dragging the total production below what it would otherwise be. No man can figure this loss or fix responsibility upon given animals save by the daily use of the scales and the careful record of each cow's production.

Milk making claims the attention of a large per cent of the farmers of New England. At two cents per quart, or practically one dollar per hundred pounds, the variations in the average herd are so wide as to astonish him who has not applied the individual test. This price means fifty dollars income from a cow producing five thousand pounds, and leaves little profit. It means eighty dollars for her mate, yielding eight thousand pounds yearly,—a good profit. The variations in many herds not selected by the scales range from thirty-five hundred to eight thousand pounds per cow, and the owner in such a case would be better off if he did a smaller business. To carry the illustration further, let us suppose that eight cows yield from six to eight thousand pounds of milk yearly, with an average of seven thousand. They would return seventy dollars per head, a total of five hundred and sixty dollars; also that the other four range from thirty-five hundred to five thousand,—an average of four thousand,—and we have as the total of the

twelve cows seven hundred and twenty dollars, or an average of sixty dollars per head. Had the weeding process been applied, and six thousand pounds established as the minimum, the profit would have been one hundred and twenty dollars more than at the present, — for, be it remembered, these higher figures deal with profit entirely. If it costs fifty dollars per head to keep a cow, we have in one case a net balance over cost of keep of one hundred and twenty dollars and in the other of two hundred and forty. Supposing the four cows are removed from the herd, and the production of the eight would return one hundred and sixty dollars net profit, and the owner is richer by forty dollars than with the twelve. This is a supposable case, but in a large number of herds as wide variations will be found, and as great a per cent of cows not yielding enough to pay the bills for hay, grain, pasturage and ensilage.

The scales and record for three hundred and sixty-five days form the only reliable test, and the story these tell must be final with him who makes milk for market.

Another loss along the same line lies in producing five per cent milk for a four per cent market and standard. The standard established by law or agreement is to be met, but there is no reason why the producer should exceed that in value, and give something for which he obtains no equivalent. This calls for the selection of stock by the Babcock test. Milk and butter fat are the products of nerve force, and it is this which exhausts vitality most rapidly. For this reason the producer must protect himself from waste by wise selection with reference to the work the animal is to perform. Economy here points to a conservation of nerve force, — an item which receives far too little attention. We save at the spigot and waste at the bung, when the principle here involved is not applied by the individual farmer to his individual animals. The standard is to be met, but skill and care are called for not to exceed unless price is proportionately increased. Deliver what your contract calls for, and then protect yourself from loss.

In butter making the question rests solely on production of butter fat, with the same exactions regarding individuals.

In both cases breeds become of secondary importance. A close study of the cost of the product desired from individual animals is the only way by which one can open the way to larger yield and less expense. Profitable cows are to be bred, not purchased. Herds are to be established, not picked up. The dominating will of an objective mind, filled with a high ideal of quantity or quality, alone can breed up to that standard of profit consistent with good business. Males are to be selected with sole reference to their virile energy and prepotent powers to transmit, in exceptional degree, the tendencies which, under wise guidance, may be developed into fixed habits. Profitable dairy herds or animals are not accidents.

Viewing the problem from the business stand-point, the greatest saving in our milk or butter departments will come by a strict application of the law of selection of individuals, the sharp weeding out of non-profitable cows, the breeding of future herds from sires and dams of pronounced merit, and the casting one side of all calves which do not give evidence of vitality and promise of great production. Color of markings plays no part in the consideration of the question from a milk or butter stand-point; but quality of hair and skin, evidence of udder, size and location of teats, looseness of tissue about the udder, thickness of abdominal wall and size of navel are points not to be passed over carelessly. Future cows will carry the evidences of worth at birth in udder structure and conformation, while the story of endurance may be read in the strength of the abdominal wall about the umbilicus. It does not pay to raise heifer calves upon a chance basis.

Breeders of pure-bred stock must follow sharply the requirements of the standard established by their associations, and combine fancy and utility; but the milk maker has the single standard of business by which to measure the individual heifer or cow. On my desk lies a letter from a milk maker, who in six years has built up the cows of his herd from six to nine, ten, twelve and thirteen thousand pounds of milk each per year. One cow, which gave 9,474 pounds in 1899, increased to 13,708 in 1900, and in 194 days, from

Oct. 15, 1900, to May 1, 1901, yielded up 11,120 pounds. That she will break her record before October there is no question, and this upon a steady working ration for business, producing milk to sell at the factory from 80 cents to \$1.38 per hundred pounds, to test $3\frac{3}{4}$ per cent, the price being graded for the year, the average about \$1.12. This cow's milk brought her owner in 1900 \$157.03, and for the 194 days named, \$139.81. Every cow in this large herd over four years must yield yearly not less than \$100 at these factory prices, or she goes to the block or market. The measure is by individuals, and this insures profit.

The study of the food question is of equal importance with that of breeding. As conditions change, practices are to be modified. Supplemental foods must to-day be increased, that the ill effects of drought at any season of the year may be overcome. No shrinkage in product can be permitted which care and food might prevent. The silo for every day in the year promises to become a necessity with the milk producer, as by its use the feeder can control the inevitable changes of the season, and supply succulent food to supplement the pastures or relieve the hay mow. The item of grain purchased is an important one with dairymen, and if, by the use of ensilage, Hungarian, oats, rye, barley or other succulent crops, a saving is possible, good business demands immediate action looking to an increase of these crops.

Still another question facing the grower of any crop is that of cost per ton, per bushel or per hundred pounds. In this are involved all the contingents of soil adaptability, soil cultivation, quality of seed and cost of fertilizer. That the question of soil adaptability to given crops is not appreciated there can be no doubt, and economy suggests more critical study. That cultivation plays a more important part than has yet been reckoned must be admitted. Marked results obtained by and through continued and complete cultivation demonstrate the importance of attention to this one important step.

The value of experimentation in the development of seeds to produce crops of fine quality and which will mature early must be admitted, and the use of such must be depended

upon by him who would realize most. A few days' time in perfecting the crop may determine its profit or loss. Then, too, buyers are critical, and their fancy forms the one standard which must control the grower. To fit the market most completely, and not fight it in the least, calls for a sharp and discriminating appreciation of the changing tastes of consumers. The universal appreciation of this condition and its liability to changes form one of the difficult problems the grower is obliged to face; yet he who keeps in closest touch with the palates of his customers and best pleases their epicurean tastes will be the one to realize most out of his growing crops. Last, but by no means least, in the consideration of this question, must be reckoned the fertilizer item: and, whether one purchases the elements to combine himself or obtains his supply in the open market, the labors of the manufacturer must be recognized. Dependent as we so largely are upon the market for the supply of plant food, the services of the scientist in fixing values and determining what single or combined fertilizer promises to give the best results with any given crop must be relied upon more and more by him who studies the economics of the question and seeks to feed for most complete results. The day has passed for blunderbuss methods of fertilization, and skill and care are demanded in the selection of the elements wanted for any given crop.

Right here may well be enforced the old lesson of saving and utilizing the natural accumulations about the barns, yards, cesspools and sink spouts. Thousands upon thousands of dollars are lost yearly by the farmers of every State through failure to properly save the solids, and especially the liquids, from the stock, protect from leaching under the eaves, and hold by the free use of absorbents the accumulations everywhere, that out of all these we very largely increase the crop-producing power of the land. The most intelligent use of the combined fertilizer on the market will be secured by him who, through skill and economy, utilizes to the utmost the wastes about the farm.

One of the growing industries in New England, and one to be fostered in every way, is that of poultry culture: yet

there is in no field such neglect of the principles of economy as here. Men forget that breeds are simply the result of the painstaking care and skill of individual enthusiasts, and that, unless held to the level of large production by the well-defined purpose of the breeder, they revert rapidly to their natural state. The experiment lately made at the Maine Experiment Station reveals the situation facing every grower. By careful supervision it was found that, while the best layer in a flock of ten produced over two hundred eggs in a year, the worst loafer produced but thirty-six. This suggests that fifty per cent of the flocks, save perhaps the Leghorns and Minorcas, might be wiped out of existence, and greater profit realized by the State. We carry altogether too much dead wood in our poultry yards. From the close of the hatching season until it opens again, males are a positive injury in the flock. Their sole value lies in their power to fertilize eggs, and fertilized eggs, outside of the hatching season, are an abomination. Consumers want fresh eggs, and as decay commences in the dead germ, the importance of non-fertilized eggs for the market must be realized. Eggs from hens running free from males will, if cared for, keep fresh nearly twice as long as the same eggs fertilized. Poultry should be made to play a more important part in fertilizing the crops, and by floorings under the roosts and the sweeping of the droppings daily into a pail or basket, where they can be carried to a dry storeroom and mixed with dry earth, muck or plaster, a most valuable fertilizer will be obtained.

No hen should be kept after two years old unless wanted solely as a breeder, and it is better to send to market at the close of the first year's laying season. A sharp distinction may well be made between keeping a flock from which to breed and one simply to produce eggs for the market. In the multiplicity of breeds there is danger of losing rather than gaining, all depending upon the appreciation by the individual breeder. We have reached a point where production in good-sized flocks should exceed twelve dozen per head yearly. This can be realized only by a sharp weeding out of the one-hundred-egg hens. It practically costs

as much to keep a six-dozen as a twelve-dozen hen. If our flocks were cleared of all surplus males and worthless females, of all old, sick, infirm and valueless stock, the saving would be enormous. Many a flock of hens is being kept at no profit, simply because their owner is loading the producers with a burden of waste stock which eats up all the profit.

In all breeding we have first the tendency, then the habit; the habit follows the tendency, and therefore it is in the earlier state that control is easiest and most successful. In spite of this, the great majority of flocks grown this year will be allowed to run together, males and females, with the one thought of size and fat on the part of the males, forgetting that the pullets mature earlier, that fat is an obstacle to egg production, and the natural tendencies are unconsciously being turned into habits of fat forming. Viewing the question as an economic problem, these conditions are all to be noted as helps or hindrances to success. Grow the cockerels for the end you desire them to reach, but think of every pullet as a possible profit bearer to you, and let her mature with no thought but of strengthening the natural functions of egg production. There are some things which may be forced, but these are all crude or mechanical: all the higher and finer products come by invitation. This applies equally to the fruit or vegetable grower and the horticulturist as to the crop producer and feeder.

Another important step which economy dictates is that of protecting stock, crops and fruit from myriad pests and diseases. That this imposes severe obligations there is no question, but it offers the only economic solution of the difficulty. Healthy animals, plants and growing crops alone can return the largest yield and finest quality. More sunlight and fresh air in the tie-ups will retard the activity of disease germs: better protection from flies will increase the flow of milk. Whatever destroys any portion of the leaves on the growing plant or tree destroys also its power to reproduce in largest quantity or to mature to greatest perfection. Thus the spray pump, the insecticide, the fungicide and bug destroyer, the solution to prevent scab, and any and all agents which, intelligently used, enable the plant or grow-

ing tree to completely mature its fruit or seed, are absolutely necessary from a purely economic stand-point.

Rural life, while it insures fixedness of ideas and principles, needs the friction of contact to vitalize into positive action; and this suggests the importance of the agricultural press, the bulletin, the institute, work of the Board of Agriculture and the grange. It must be true that he who rises to the fullest grasp of the situation confronting to-day utilizes all possible helps, seeks all avenues of assistance. So many conflicting agencies are at work that there is forced upon the individual the imperative need of allying himself with every agency which can in any way promote his prosperity. It is economy to avail one's self of the assistance of these agencies; it is waste to refuse. So long as these fill their sphere, stimulate thought and arouse ambition, they are helpful in the extreme; this is their mission. No industry can thrive to-day without its representative publication. A live farm paper, aggressive, fearless, outspoken and sound, is a positive necessity in the home of every man who would fill his place as a producer and salesman of the products of the farm. By and through it alone can he keep touch with moving currents of trade, watch over the changing markets, and have brought fresh to his door the work being accomplished by the scientist and student. The bulletins and reports of the Board constitute a library of agricultural thought, investigation and results too valuable to be lost by any tiller of the soil.

The institute for the discussion of live questions of vital importance to the community has long been recognized as a potent factor in every State, yet to be of greatest value it must claim the attention and command the presence of every man who tills a farm. Its province is the presentation of live agricultural problems in a manner not to confirm past practices but to stimulate thought and provoke discussion. He who denies himself the privileges and benefits of the well-conducted agricultural institute is a loser in the struggle of to-day. The institute must be made of greater service, its mission needs be more clearly defined and appreciated, its discussions claim the attention of a wider circle.

The grange is so interwoven with the social, educational, agricultural and home life of New England, that there can be no fair analysis of existing conditions which does not include the work of this organization. Its field is peculiar. It cannot take the place or do the work belonging to any other agent. It holds by the bonds of sentiment, it helps by kindling enthusiasm. It must ever be the ally of every agent set for the promotion of the farm home and home farm, and for these reasons every consideration of economy should urge the individual farmer to unite in this farmers' organization for those enduring results which are not to be obtained through any other channel. A live, earnest, working grange, loyal to its declarations of principles, is one of the strongest promoters of fidelity and enthusiasm the country home can have.

May it not be that the evident drift of all forms of business into what are termed trusts furnishes a good illustration of that spirit of practical co-operation which must extend over the farms before the avenues of waste can be checked? The writer is familiar with a section fifteen miles from market, where ten farmers living on one road and in one school district spend one day every two weeks in going to market with their butter, cheese, eggs, potatoes, etc. One man could do the business for the whole by going weekly, as each has his regular customers. The loss to this school district amounts to two hundred and eight days yearly, less the extra expense to be paid for delivering. The manufacturers have accepted the inevitable lesson, and combined. Why should not the farmers? The principle is sound. Its application may be extended in many directions. It must come in the not far distant future, in order that all that is possible may be realized from their labors. It suggests almost limitless possibilities along the lines adopted by our corporate interests.

Economy is not parsimony, and therefore to realize most, one must expend wisely. My thought is that good business demands the application of the same spirit of enterprise by the farmer as by the manufacturer. If a new machine will do more and better work than the old, reducing cost in any

direction, its purchase is economy. Many a man has gained by setting one side a five-foot mower and buying a longer cut. The value of all machines must be gauged by results. Hand labor is more and more to be superseded by machinery, but this necessitates larger operations, that the relative profit may not be reduced. It reduces labor in one direction, that more may be done in another. These labor-saving machines are not intended to relieve the brain, but the hand. The man saves physical force that he may expend mental, and out of this expenditure obtain what formerly was impossible.

A large item of loss on many farms is the time necessary to move from field to field in order to complete any given work, and the same lesson applies with equal force to the majority of manufacturers. We turn too many short furrows, cultivate too many fractions of an acre, travel over too much territory to grow our crops. Economy suggests the massing of land under the plow, and the systematic going over the whole farm by a short-term rotation. Standing one day recently looking over the well-tilled fields of a middle-aged farmer, there could be counted ten lots of land under the plow, scattered all over the farm, four or five of which covered considerably less than an acre each. If these could have been in one lot, the saving of labor in cultivation and travel would be no mean item. Asking a Kansas corn grower how he made money, his reply was, "By the length of the corn rows." He reduced loss of time and labor to the minimum.

Discussing this question from a purely business standpoint, with reference to the economies possible, these are a few which are suggested. They all or nearly all apply with equal force to other lines of labor, and only illustrate the fact that occupation does not settle the question, and that waste is universal. At the same time, here are some of the steps which may be taken to still further reduce the cost of production, and leave in the pocket of the producer the evidence of a more satisfactory year's business.

Asking of nature that she return in ever-increasing ratio and in constantly improving quality, there come correspond-

ingly increasing obligations upon the grower and producer, which must be appreciated and observed. Discussing the situation from the business side, with special reference to reducing cost of production, these important considerations present themselves with a force not to be lost by the thinking producer.

The wastes which must be eliminated before the industry reaches its higher levels are not alone along the lines already suggested, but bear a direct application to the individual farmer. To-day the successful farmer is not only a mechanic, but an artist; he realizes the necessity for reducing the cost of production, and, to a degree, of frictionless machines, whether animate or inanimate; but to succeed he must have an artist's outlook, he must see clearly before him the perfected crop, the ideal structure in the animals constituting his herd, and pronounced individuality in each necessary for large service; and with this large, full appreciation there will be wanted the same unbounded enthusiasm found in the ranks of the mechanic, the tradesman or the specialist.

Here is the field for future operations. Men succeed not solely out of intuitive perceptions, but because these have been sharpened and made critical through study and investigation, because they have grown into large comprehension of underlying principles, and, by the force of a dominant will, intelligently invite their flocks and herds out into ever-broadening fields of service. Here is the demand for economy of nerve force on the part of the producer; here the opportunity to make the conscious and unconscious forces of nature yield greater returns; here the field wherein waste forces are to be utilized, sympathetic relations established, and our agriculture made real, positive, strong, invigorating and attractive to the coming generation.

SELECTION AND IMPROVEMENT OF THE DAIRY HERD.

BY PROF. F. S. COOLEY, PROFESSOR OF ANIMAL HUSBANDRY AND DAIRY-
ING, MASSACHUSETTS AGRICULTURAL COLLEGE.

That the cows of Massachusetts are producing as much as the standard of good husbandry calls for, no well-informed agriculturist would be optimistic enough to assert. A glance at a few facts in regard to milk and butter production will be suggestive to any one interested in the matter. According to Maj. Henry E. Alvord, chief of the dairy division of the United States Department of Agriculture, the average cow gives about 3,000 pounds of milk, yielding 125 to 130 pounds of butter per annum. Dr. J. B. Lindsey's estimate, after a canvass of representative creamery districts, of 150 pounds of butter per cow per annum, is very near to Alvord's figures for Massachusetts. In my own canvass, during the summer of 1899, of all the creameries in the State, 175 pounds of butter per cow was found to be the average annual yield. This would indicate the milk flow to be about 1,700 quarts, worth \$42.50, at 2½ cents a quart. One hundred and seventy-five pounds of butter at 22 cents per pound would amount to \$38.50, and, adding the price of 1,500 quarts of skim-milk, worth 1⅓ cent per quart, we would have \$43.50 as the value of the butter and skim-milk. It is doubtful whether \$43.50 will pay for a year's keep of a cow at average prices; certain is it that such a sum cannot leave a very wide margin of profit.

Cows are to be found that are better than the average, — producing 400 to 500 pounds of butter and 8,000 to 12,000 pounds of milk in a year. At the foregoing price for milk, such cows return \$100 to \$150 per year for feed consumed. The extra feed consumed will hardly be in proportion to the gain in product, so that with increased capacity comes

greater profit. The greater profit almost invariably accompanies the higher rate of production.

By these comparisons between average and extra cows is brought out the apparent advantage of keeping the latter, and yet the difference in value between them is generally very much underestimated. Consider for a moment the average cow, making an annual product of 1,700 quarts of milk, worth \$42.50, the cost for her keeping being \$40. Another cow consumes \$50 worth of feed and produces 2,500 quarts of milk, worth \$62.50. A still better cow, at a cost of \$65 for maintenance, produces 4,000 quarts of milk, worth \$100. Two dollars and fifty cents, \$12.50 and \$35 represent the respective profits earned by these cows. If we assume the value of the cow in each case to be her beef value (say \$30), plus the additional sum upon which she will pay $8\frac{1}{3}$ per cent interest, taxes and insurance, and 25 per cent depreciation, then cow No. 1 is worth \$37.50, No. 2 is worth \$67.50 and No. 3 is worth \$135. These values are real, provided the useful period of the cow in question is four years. If the period is longer or shorter than that, a proportionally greater or less value would obtain. If the useful period of a cow is three years, the depreciation factor should be $33\frac{1}{3}$ per cent; or if it is five years, 20 per cent. While these values are in no sense fictitious, they are not commensurate with the market prices. The \$37.50 cow will probably cost \$40, and allow her purchaser to lose \$2.50 on the trade. The \$67.50 cow will cost from \$50 to \$55, and leave a fair margin for the risk taken. The \$135 cow will cost possibly \$70 to \$80, and prove the best bargain of the three.

Carrying out these comparisons for herds of 20 cows of each grade, each herd to be bought at the foregoing prices, kept for four years and then sold for beef at \$30 each, we have the following:—

| | | Dr. | |
|--------|---|-----|---------|
| No. 1. | To 20 cows at \$40 each, | | \$800 |
| | To keeping four years at \$40 per cow per annum, | | 3,200 |
| | To interest, taxes and insurance on purchase at 8 per cent, | | 256 |
| | | | <hr/> |
| | | | \$4,256 |

CR.

| | | |
|--------|--|---------|
| No. 1. | By 136,000 quarts of milk at 2½ cents, | \$3,400 |
| | By 20 beeves at \$30, | 600 |
| | By loss, | 256 |
| | | <hr/> |
| | | \$4,256 |
| | | <hr/> |

DR.

| | | |
|--------|---|---------|
| No. 2. | To 20 cows at \$52.50, | \$1,050 |
| | To keeping four years at \$50, | 4,000 |
| | To interest, taxes and insurance on purchase at 8 per cent, | 336 |
| | To profit, | 214 |
| | | <hr/> |
| | | \$5,600 |

CR.

| | |
|---|---------|
| By 200,000 quarts milk at 2½ cents, | \$5,000 |
| By 20 beeves at \$30, | 600 |
| | <hr/> |
| | \$5,600 |
| | <hr/> |

DR.

| | | |
|--------|---|---------|
| No. 3. | To 20 cows at \$75, | \$1,500 |
| | To keeping four years at \$65, | 5,200 |
| | To interest, taxes and insurance at 8 per cent, | 480 |
| | To profit, | 1,420 |
| | | <hr/> |
| | | \$8,600 |

CR.

| | |
|---|---------|
| By 320,000 quarts milk at 2½ cents, | \$8,000 |
| By 20 beeves at \$30, | 600 |
| | <hr/> |
| | \$8,600 |
| | <hr/> |

These balances ignore entirely credits for calves dropped, which would be much greater with the best cows. It becomes apparent that the advantage is decidedly with the \$75 cows, so that good husbandry demands that earnest effort be put forth to secure the best for milking purposes.

My own herd, all of which has been bought, as occasion offered, at an average cost of \$43.50 per head, and kept for about \$65 per head per year, has produced an average annual yield of 7,576 pounds of milk. These cows are at a disadvantage where milk alone is considered, as their milk is rich in fat, giving a relatively high butter product. A

fairer basis for comparison is the pounds of butter fat obtained. Quarts of milk are taken in this discussion merely for simplicity of expression.

I am acquainted with large herds producing from 300 to 400 pounds of butter per cow, and averaging from 6,000 to 8,000 quarts of milk. No progressive dairyman ought to be satisfied with less than 400 pounds of butter as the average annual product of his herd, nor keep a cow not capable of yielding at least 300 pounds. "Cow boarders" should be disposed of without hesitation for what they will bring.

HOW TO KNOW A GOOD COW.

Judges of dairy stock differ more or less in their methods of selection, and the relative importance they attach to the points presented. There is a general similarity of observation and opinion; but I am aware that in attempting to describe those points which I consider most essential I shall lay myself open to criticism by other and perhaps better judges of milk and butter cows. Perhaps such criticism would be helpful rather than otherwise.

The essential points in the conformation of a dairy cow are, briefly, and about in the order given:—

1. Udder capacious, with broad attachment.
2. Body large and deep.
3. Hind quarters wide and strong.
4. Fore quarters spare fleshed and rather openly jointed.
5. Milk-veins, skin, hair, temperament, etc., indicating large milking powers.

To enlarge on these points in detail:—

1. *The Udder.*—Capacity is the chief requirement in a good udder, but it is not always indicated by the size and shape of the organ. An udder may be large and yet meaty and not capacious; or it may be unsymmetrical and yet elaborate a large quantity of milk. It must be long and broad in its attachment to the body, becoming more let down with advancing age, but not pendulous. If it extends well up behind and well forward, and has great width, its capacity is assured, regardless of its vertical dimension. As a fancy point, teats squarely placed and wide apart are

desirable, but this does not always assure large milking powers, or a lack of it the reverse. The placement of the teats is indicative of milk yield, but not infallible. Even symmetry of the quarters may not be a guarantee of good milking powers, although a tipped-up udder mars the beauty of a cow. Avoid an udder that begins too low down in the twist and extends only moderately well forward, even if it is large and pendulous. Size and shape of teats are matters of convenience in milking. It must be borne in mind, however, that anything that saves labor is a great advantage on the farm, as well as elsewhere; and a hard, slow-milking cow, requiring five or ten minutes more than the average time for milking daily, means an extra expenditure of from \$4 to \$8 per year for attendance. She ought to be discounted from \$10 to \$15 in price on this account.

2. *Size of Barrel.* — A long, deep, capacious body is one of the essentials of milking power often lost sight of, yet nevertheless of prime importance. Often we hear that the cow is “a hard-worked animal,” and it is true that a large expenditure of energy is involved in the conversion of the coarse forage on which she subsists into milk. This elaboration is most economically carried on in a large and perfectly organized laboratory. A wasp-waisted cow rarely proves particularly profitable in the dairy. Much more stress ought to be laid on the length and depth of the barrel than is now the case, whether one is selecting breeding stock or merely purchasing milkers for present needs.

3. *Hind Quarters.* — That milk production is closely associated with the maternal function is not to be disputed. The conformation generally conceded to be most desirable for breeding is, therefore, to be also sought in a dairy cow. Wide, rather prominent hips and a roomy pelvis are considered important. The rump should be long and level, and, notwithstanding the fact that many good cows have had sloping and peaked rumps, such a conformation mars the beauty of a cow, reduces her value in the market and adds nothing to her dairy capacity. Good depth of quarters is also desirable, and at least moderate straightness on their back and sides. Extremely cat-hammed

animals are not so much prized as formerly. The milch cow differs from her beef cousin in having an open twist, with her udder filling the place where meat ought to be in the latter.

4. *Light Fore End.* — This is relative rather than absolute, and may be overdone. The head is longer than in the beef type; the neck longer, and not so well filled in the neck vein. The shoulders are not so wide, and are more prominent at the withers. The crops are slacker, and the anterior vertebræ more prominent. The articulation of the bones is looser, with longer spinus processes. The ribs are not so well sprung, giving a fish-backed rather than a hooped effect. The general conformation is lighter, longer and less compact than in beef stock; yet this lightness must not be extreme, as anything that produces delicacy and lack of constitutional vigor detracts from the usefulness of the animal. There must be, therefore, no crowding of the vital organs, but reasonably large lung capacity should be sought, measured by good heart girth.

5. *Superficial Points.* — According to age, large milk veins are indicative of large milk secretion. Good size or double extension of the vein is desirable. Length, secured either by tortuous, convoluted shape, or by extending far forward, as well as numerous prominent branches on belly and udder, add to the value of the animal. The “milk wells,” or orifices through which the milk veins enter the abdominal cavity, must be large and numerous. The real significance of milk veins is found in their function in the circulatory system of the udder. An udder well supplied with blood vessels is more highly organized than one not so well provided. Blood is the source of milk, and its abundance in the udder is indicated by the extent of the circulatory system, of which the milk veins are the sensible portion.

The skin ought to be mellow and not too thick, its mellowness, again, being an indication of a good circulatory system so essential to milk secretion.

The hair ought to be fine and close-lying, according to breed. Long, mossy hair is the mark of beef stock.

The escutcheon is a point of minor importance. While some dairymen lay much stress on a good escutcheon, and while, coupled with other indications of excellence, it is useful, without this accompaniment of other dairy points it loses its significance and importance. Many of our best authorities now pay very little attention to the escutcheon. There is often danger of letting some hobby of minor consideration obscure the real essentials in judging.

The yellow pigment on the skin is indicative of the richness of the product rather than its amount, hence its main use is to show the kind of milk given.

Temperament is something carefully observed by some cattle experts, but it is rather intangible to the uninitiated. The dairy temperament is nervous rather than lymphatic. It should give the effect of suppressed rather than active nervousness.

HOW TO SECURE GOOD COWS.

Whether one acquires his dairy stock chiefly by breeding or by purchase, the latter method must be depended upon more or less, and a knowledge of the foregoing dairy points is a useful aid in making selections. Purchase of stock is attended with many disadvantages that do not hold in breeding. There is an uncertainty of the capacity of purchased cows. Select as carefully as we will, we shall often be disappointed in the product of the cows we buy. There is often also a great shrinkage in the yield of milk from cows of known excellence when subjected to different conditions of food and management. Defects are often found in purchased cows that could easily account for their sale. Cows with weak quarters, and hard or defective milkers, are very common among sale stock. Unpleasant habits, such as kicking, fence-breaking, self-sucking, etc., may be found among one's purchases. There is the further possibility of introducing disease into the herd by purchase. Perhaps the most common disorders thus transferred are abortion and tuberculosis.

One is not entirely free from such troubles in rearing his own cows, but he will greatly diminish the chances of introducing them, and prevent them to a large extent. He

will be able to get a better class of cows by breeding, avoid uncertainties, and pass inferior animals on to the butcher.

The cow is not a "machine," with regularly listed speed and capacity, but is vastly more susceptible to external conditions than most machinery. Her capacity depends not only on her own inherent power of work, but also on a hundred other things, — food, water, regularity of attendance, heat, flies, bed, exposure, worry, etc. This is not all. The same cows, with as nearly the same treatment as possible, on the same farm, will vary greatly from one year to another. One cow is biennial, like an apple tree, — giving a large product every other year, alternating with a year of rest and recuperation, in which she does not pay her keep; another falls off without any apparent reason. There are also the exigencies of retained afterbirth, milk fever, garget or accident, which put the very best cows temporarily or permanently on the list of boarders. Perhaps it is not too much to say that a cow rarely does particularly well after a year in which she has made a phenomenal product.

BREEDING FOR IMPROVEMENT.

In grading up a herd, one must first decide upon the kind of cattle that most nearly meet his requirements. No discussion of breeds is here intended. Jerseys, Holstein-Friesians, Guernseys, Ayrshires, Shorthorns, Dutch Belted, Devons, Red Polls, Brown-Swiss, etc., all have their strong points, and each is adapted to its own peculiar place better than any of the others. Do not try to keep Shorthorns where Ayrshires are more appropriate, nor Holstein-Friesians where Devons would do better. Selection must be made with reference to the qualities wanted and should be permanent. I have no patience with the continual change from one breed to another, which so often results in a heterogeneous collection of misfits of indefinite characters. Choose the breed best adapted to your requirements, and then select with equal care the individuals that go to make up your herd. The individual within a breed is of greater importance than the breed itself. There are many scrub pure-breds, no better than common scrubs, but more dangerous because of

conjuring with pedigree. Pedigree is valuable as a reason for excellence, but not as an excuse for mediocrity.

Then there are different characters within a breed, and one must not only select the general type but the particular qualities wanted. Do not try to breed butter fat into Holstein milk by a Jersey cross, but rather select Holsteins of a family known to be richer than the general run. Do not cross rich Jerseys deficient in quantity with another breed, hoping to remedy the defect, but find a Jersey strong in quantity for the purpose. Remember in selecting that it is the individual as well as the breed that determines the characters likely to be transmitted, and seek diligently within the breed for those qualities needed for the purpose in view.

The Bull.

The old saying, "The bull is half the herd," is not the whole truth. He is, or else he isn't, according to the strength with which he transmits the qualities he possesses. I sometimes find a scrub bull which is not half the herd because the cows with which he is mated have the stronger inheritance, and transmit their qualities with greater intensity than he. On the other hand, as a power for degeneration he is often more than half. In improvement it has been said that the cows should be depended on to maintain the standard of excellence reached, but any raising of that standard must come through the bull. Among grade cows a pure-bred sire ought to exert by far the greater influence over the qualities of the progeny. For these reasons much greater care ought to be bestowed in the selection of the male breeding animal. It would be better in most cases to select the bull less frequently, and be more particular about his quality. The practice of buying a calf or a yearling and selling him after a few months' service has worked much injury to our breeding interests. By selecting more carefully, and, after excellence is proved, keeping as long as possible, one-half the bulls might be dispensed with, and the remainder maintain a much higher standard of quality.

Many bulls are destroyed before their qualities are known. If good, there is no chance to duplicate their good work. If

bad, the mischief has already been done. The difference in value between good and poor bulls is much wider than is commonly believed. Even in getting bob or veal calves there may easily be a difference of from 50 cents to \$2 per head in what they are worth, amounting to from \$20 to \$100 in a year's service. If, however, a bull is destined to be the sire of heifers to replenish the herd, those from a good bull are worth at maturity from \$10 to \$25 per head more than those from a scrub. In four years' service this may amount to from \$400 to \$1,000, even in a grade herd, and easily warrant an outlay of from \$200 to \$500 for a young sire of superior merit. Very well-bred and promising young bulls may be bought at from \$50 to \$100 apiece, and it is poor husbandry to pass such chances by to purchase scrub stock.

An acquaintance told me a short time ago that he was done buying cheap bulls. He had had abortion, impotency and other troubles enough. He had just paid \$23 for a really good service bull. It reminded me of the colored man who bought a horse for 75 cents, which died on the way home. He remarked, "I'll hab a good hors nex' time, if it cost foah dollars." It is not good husbandry to support a low-grade bull. It will pay even an ordinary grade breeder to keep an animal worth \$100.

Some attention must be paid in selection to correcting the defects of the other sex. Pedigree should count, but individual merit counts more. The value of pedigree depends mainly upon the character of the immediate ancestors. Excellence in remote ancestors, interesting and desirable though it is, must not be allowed to cover up deficiencies in parents or grandparents. Much conjuring is done with the names of great ancestors who would doubtless be ashamed to own some of the descendants now claiming their ancestry. There is also a prepotency in some individuals that clothes them with unusual power to stamp their qualities on their get. This is partly the effect of pure breeding, but it is only an occasional sire that manifests it strongly. When such a sire is found, he should be duly prized, and retained in service as long as possible.

Rearing and Developing Heifers.

Some attention may well be paid to the selection of heifer calves. Those of very small size, or weak or seriously defective, have no place in the young herd. We are accustomed to have much regard to the parentage, and we do well; but no less attention is due to the young heifer herself. The next consideration is the growth of the calf. At no period can growth be more economically secured than during calfhood. Only choice registered calves are reared on whole milk in this State, and it is doubtful if it will pay to use whole milk for common stock where a cheaper substitute is available. A set-back during the first few weeks is hard to overcome afterwards. Feeding a little whole milk in the ration during the first month is one of the best ways of insuring against set-backs.

My practice of rearing calves has been to separate the calf from its dam after the first full meal. It is taught to drink and feed on its mother's milk for a week, in moderate feeds twice a day. Warm separator milk is gradually substituted during the second week, until it forms almost the entire feed. About a quart of new milk per day is fed till the end of the first month. Two feeds daily are given, always warm and never excessive in amount; but three feeds per day would be better. Calves are taught to eat dry grain after two weeks old, and given *ad libitum* a mixture of corn meal, oil meal, bran and ground oats, in about equal parts. Coarse forage — hay, silage or grass — is always supplied to the extent of the calf's appetite.

The horns are removed by the use of caustic potash during the first two weeks, thus securing the benefits of dehorned cows without disfigurement or trouble.

While calves grow faster in almost complete confinement, a hardier and more rugged cow results where they have daily exercise in yard or pasture. The feed of skim-milk is continued during most of the first year, if the supply does not fall short. At all events, growth must be kept rapid by liberal feeding, until the heifers are sent off to pasture. Here, again, it is poor economy to keep stock on

short feed. A stunted growth is a great loss to the breeder. During the second winter heifers receive a small feed of the grain mixture given to the milking stock, consisting of gluten feed and cotton-seed or other concentrate, corn meal and bran. The main thing is to keep growth active. Size in a dairy cow adds much to her value, either in the dairy or sale ring.

Breeding should not take place until after the heifer is eighteen months old. Some of the best cows I have seen were allowed to reach two years old before being bred. It is significant that some beef breeders do not receive for registry, as pure-bred, calves from pure-bred parents where the dam is under twenty-seven months old at the time of calving. Breeding too young detracts much from the usefulness of heifers. The season of the year for breeding is purely a matter of convenience, and need not be considered in this paper. The interval between successive calves is commonly one year, but it is noticeable that cows do very much better after a longer interval. This is especially true in young cows. If an interval of fifteen to eighteen months is allowed between first and second calves, the cow makes a considerable growth that enhances her value and increases her capacity for milk.

Young cows require to be liberally fed. It must be borne in mind that the two-year-old cow has not only to yield milk, but also complete her growth. If concentrates are withheld at this time, on the mistaken notion that they are injurious to young cows, not only is her milk flow lessened, but she is hindered from reaching her most useful development. It may not be desirable to crowd young heifers with heavy feed, but when they milk deeply there must be the material to supply the drain, just as well as in mature cows.

CRANBERRY CULTURE IN SOUTH-EASTERN MASSACHUSETTS.

BY JOHN BURSLEY, WEST BARNSTABLE, MASS.

The cultivation of the cranberry was quite general in Barnstable County from 1850 to 1865. In the year 1850 Edward Thacher of Yarmouth submitted the management of one and one-half acres of land, set by him to the cranberry in 1846, for the premium offered by the Barnstable County Agricultural Society for the cultivation of the berry. From 1865 to 1875, or during the years following our civil war, the planting of the berry was largely increased, the high prices then received for the fruit having stimulated this increase of acreage.

While a large portion of the area then cultivated still continues to yield profitable returns, there are large tracts which, on account of their not being naturally adapted to the fruit, and because of the poor management of their owners, have been allowed to return to their original condition, namely, swampy, marshy quagmires, bearing only coarse, water-loving grasses, bushes and briers. Under favorable conditions and good business management the crop continues a very profitable one, even at prices of the present season, — \$5 per barrel at Cape shipping points.

From 1875 to 1885, acres of bogs previously unproductive in Plymouth and Bristol counties were reclaimed and planted to the berry. Many of these tracts are of quite large areas, and are largely managed by some of the men who began the growing of the fruit in Barnstable County. The reclaiming of these large swamps (which were totally unproductive, and in many instances almost a menace to health), making them some of the most productive lands of the section, is surely evidence of good farming, and those who have care-

fully managed the planting, growing, harvesting and marketing of the crop have proved to be public benefactors.

To such magnitude has the cultivation of the fruit in south-eastern New England grown, that the crop harvested this year is estimated at 225,000 barrels, while the crop of New Jersey and the entire west is only estimated at 115,000 barrels. The New England crop alone returns to its growers, and those who are employed in the harvesting and shipping of the fruit, over \$1,200,000. While the yield in individual cases is oftentimes very large, the average yield is probably not over 25 or 30 barrels per acre per year. From a lot of $11\frac{1}{4}$ acres there have been harvested during the last thirteen years 924 barrels, or an average of about 56 barrels per acre per year. From another lot of 8 acres there have been gathered during the last ten years 2,395 barrels, or an average of about 30 barrels per acre. The past season, from a lot of less than 140 rods I have seen 148 barrels of fruit harvested, but such yields as this are not common.

The south-eastern portion of New England is especially well adapted to the crop, because frosts in that section seldom occur of sufficient severity to injure the berries before October 1, and many seasons not earlier than October 15. The land selected should have a peat or muck bottom, a site covered with trees or bushes being preferable to a grass-growing turf. The poorer the soil about this swamp, the better; a very light, sandy soil, upon a sub-soil of coarse sand rising abruptly from the edge of the swamp, should be selected. A careful survey should be made, to ascertain if the water level can be lowered from one and one-half to two feet below the surface; if this cannot be done, the swamp is not desirable for the cultivation of the fruit.

If a natural reservoir is not at hand, care should be taken to secure one above the level of the swamp, if possible, that the bog may be flooded during the winter season to protect from severe freezing, and during the spring and fall to destroy insects, of which we shall speak later. If a reservoir cannot be secured above the level of the land to be worked, oftentimes a near-by lake or large pond may be drawn upon; and, if below the level of the lot to be planted, an engine

and large pump may be used, with which the flooding can be done.

The lot having been selected, the trees and larger bushes should be cut about and their stumps tipped out by the aid of their tops and some mechanical power, a four-fold tackle being generally sufficient, though a stump puller is sometimes used. The larger wood is taken to the adjoining upland, the stumps, brush and roots burned; ditches are then cut around the outside, between the swamp to be planted and the adjoining higher land. These should be from one and one-half to two feet deep and from two to three feet wide, varying as the location be wet or dry, a very springy swamp not being as desirable as one which, though peaty or mucky, is not filled with active springs. The main water way, which is usually to be found near the centre of the swamp, should be straightened and deepened. Cross ditches are also cut, at distances of from four to eight rods apart.

The brush and wood being disposed of and the ditches completed, the surface is next made level. For this purpose thin bog or stub hoes, with a sharp cutting edge, are used, the smaller roots being cut off and raked out, when they in turn are burned or carried off. To assist in getting a level, the ditches are filled to within a few inches of the surface with water, this water line being very useful in securing the desired plane. A dam at the lower end of the tract is to be constructed, with gates, that the flowage may be regulated at will.

After the clearing, ditching and levelling have been completed, comes the sanding, for which purpose all soil is removed from the portions of the upland that the sand is to be taken from. This coarse sand is spread upon the surface to a depth of from three to six inches, more if the swamp is naturally wet or springy and inclined to a rank, vegetable growth, while the lesser depth may be sufficient if the soil is quite dry, and free from grass or water growth. This covering is usually carried on in barrows having a small wheel, these being run upon a one and one-half by eight inch plank for a track. The sand is raked to the desired thickness as fast as wheeled on, one man doing the levelling

and moving the track, while three to six men, as the distance be long or short, wheel the sand. A common wooden hand hay rake, with half the length of the teeth cut away, is used for the levelling.

We are now ready to set the plants, which is preferably done in May, or between April 15 and June 10. The level, sanded surface is marked off eighteen inches apart each way. The cuttings are secured from a good, healthy growth of vines of the desired variety, being cut off at the ground with a common butcher knife, from four to six barrels of cuttings being needed to set an acre. A bunch of from five to eight of these cuttings is pressed firmly into the sand with a dibble, to a depth of from three to five inches. The ditches are then nearly filled with water and the soil kept moist till the plants have rooted, after which the water may be dispensed with for a time, though it is well to nearly fill the ditches occasionally, if the season be very dry.

The entire cost of preparing a plantation, including clearing of wood, ditching, levelling and sanding, should not exceed \$1.25 or \$1.50 per square rod, or from \$200 to \$250 per acre. Contractors accustomed to the work are usually to be found who will construct the plantations for the prices above named.

The setting of the vines, including the marking, can be done by those proficient in the work for 10 cents per rod. These prices do not include cost of building dam or reservoir.

The bogs must be kept clear from weeds and all grass growth, hand weeding being depended upon for this purpose. The first season two or three weedings will be sufficient, unless it should be excessively wet and the location springy. The second season the vines should make a rapid growth, and twice weeding will probably be all that is necessary. The third season they should bear some fruit, though a full crop need not be expected until the fourth year. The weeds, bushes, etc., will show more or less every season as the plantation grows older, but, unless they are very troublesome, need not be taken out until after the crop is harvested, when all should be pulled, carried off and

burned. If the grower has practised clean culture, he will still have the insects and elements to contend with.

The flooding previously alluded to is necessary during the winter season that the plants may not be destroyed by freezing, as was the case during the winter of 1900 and 1901, when large tracts that were not flooded were so badly injured that they did not fruit at all during the following season. Again, if one has a reservoir with a good head of water for use at will, it is often advisable to flood, for a short time only, during the last part of May or first part of June, to destroy the "fire worm." This insect (*Rhopobota vacciniana*), often known as the vine worm or blackhead, has been very destructive in many sections of south-eastern Massachusetts. Flooding for a few hours in the early part of the season, just as the worms are hatching, has been quite satisfactory where plenty of water was at hand, but as there are only a few plantations so situated, insecticides and spraying have been resorted to. For this purpose many growers from 1885 to 1890 used a strong solution of tobacco with quite good results, while others used Paris green. At present, a solution known as arsenate of lead, prepared from a formula furnished by Professor Fernald of the Hatch Experiment Station, appears to be best of all. The spraying is done with a large force pump set upon a barrel or tank, mounted upon low, broad wheels, that it may be easily moved about the bogs. A line of hose with spray nozzle is attached, and, while two men move the tank and work the pump, a third directs the hose, thoroughly sprinkling the entire surface. Three or four applications are usually made between May 1 and July 1. It is a curious fact that some bogs are never troubled with this insect, while upon others, only a few rods away, it has entirely destroyed the crop.

The fruit or berry worm (*Mineola vaccinii*) is also quite a serious enemy, working upon the fruit only. To destroy this insect, Paris green or arsenate of lead is sometimes used, the spraying being done just after the berries are set.

The root worm, which often destroys quite large tracts, works very similarly to the common red-head white grub

that destroys our grass roots, and is, I believe, of the same family. Flooding the plantations to the level of the surface during August and September will usually check their depredations.

Many bogs are inclined to produce an excessive growth of vines, which in a few years become brittle, and many of them die. To renew these and produce a healthy growth of bearing shoots, thinning or pruning is practised. The tool for this purpose is of about the size and shape of a common wooden hand hay rake, having a steel head, to which four or five knives for teeth are attached. These knives or teeth are about three inches long, and are set about six inches apart in the head. The implement in use is drawn toward you like a hay rake, and in this way quite a portion of the vines are cut away.

If the vines have not been trimmed and have made an excessive growth, which is in places dead or very brittle, it is sometimes advisable to burn over the bog during the late autumn. Burning at this season does not affect the roots (if the ground is wet nearly to the surface), and a new growth of healthy vines may be expected, which will usually fruit the second or third year after. An inch or two of fresh sand spread among the old vines will encourage a new growth and add life to the plantation. This is best applied in the late autumn, after the fruit is harvested, when the winter flooding will settle it among the vines. If not done before the water is frozen, if spread upon the ice it will drop into place when spring comes.

If the soil has a tendency to be hard and compact, and the vines fail to make a healthy growth, a light dressing of commercial fertilizer is sometimes used with very beneficial results: one containing a large per cent of potash and phosphoric acid is to be used rather than one high in nitrogen. An application of from 300 to 500 pounds per acre is usually sufficient.

There are at present quite a number of varieties of cranberry commonly grown, though three or four only produce 75 per cent of the crop marketed. Probably fully one-half of the fruit in Barnstable and Plymouth counties is of the

Early Black variety, a very heavy cropper, ripening about September 1, and usually a fair keeper for a berry harvested so early in the season. The Early Red is also a standard early berry. Later varieties include the Howe, Belle, Bugle, Matthews, Batchelder, McFarland and Centennial. The Howe is a standard fruit, and probably more largely grown than any other late variety.

The so-called late kinds are usually in condition to harvest by September 20, and are generally all gathered by October 10. As the market is then quite well supplied with the early fruit, many of the late berries are gathered a little green and placed in the storage-houses to color and ripen.

The harvesting was formerly all done by hand, the fruit being gathered by the fingers, then when ready to be packed it was placed in long racks or screens, from which the defective berries and dirt were all taken. This large amount of hand labor made the harvesting very expensive, usually from \$3.50 to \$4.50 per barrel. The section of bog to be harvested is divided by lines placed from six to eight feet apart, two workmen usually occupying the same row.

There are now several patterns of scoops or picking machines used, the most common being a wooden box, with round, wooden teeth, twelve inches long and a half inch in diameter, projecting from the lower edge. A handle is attached to each side of the larger scoops, and the implement, which is used in both hands, will hold from ten to twenty quarts. The smaller ones have one handle on the top, the same being held in the right hand, and this will hold from six to twelve quarts. The teeth are placed just far enough apart to allow the vines to pass between them, while the fruit is drawn into the scoop. In use these scoops are plunged into the vines just below the fruit, then tipped upward and forward, this motion clearing the teeth from the vines and leaving the fruit within.

Another machine which is largely used is known as the "Lambert patent." This is smaller than the first described, holding about two quarts. It has wire teeth, about six inches long, for the lower side of the box, the top and sides

being hinged, with a movable front, which is held in place by a spring worked by the thumb, while the handle is held in the fingers. The teeth are shoved into the vines, the front is sprung to them, which pulls the berries into the scoop as it is withdrawn from the vines. This machine does not break off as many vines as the larger wooden scoop, and thus leaves the fruit in a cleaner condition.

In using these tools the pickers carry along a six or twelve quart measure, into which they empty the contents of the machine. Those using the larger scoop have bushel boxes, which, when filled, are taken to the storage or packing houses. After picking, the fruit is run through winnowing or separating machines. These have a blower or fan to remove the light dirt, with either a tightly drawn belt upon which the sound fruit bounds, or a set of little inclined shelves over which it falls, the good fruit going to one receptacle and the defective to others. The patterns now in general use are the "Economist" and the "Middlesex."

After passing through these machines most fruit will have to be examined by the practised eye and nimble fingers of women, known as screeners. For this purpose the fruit is placed in long screens or racks, from which the remaining defective berries are picked by hand. These screens have slatted bottoms, through which the very small berries drop; they are about four and one-half feet wide at the upper end, tapering to one foot, and about eight feet long, with sides six inches high. The wide end is raised three or four inches above the narrow end, which is placed over the barrel or package in which they are to be shipped. About this screen three or four women stand, removing the defective berries. Unless the fruit is very badly decayed, this number, with a man to move the fruit, will usually pack from 15 to 30 barrels per day.

The bulk of the crop is marketed in barrels holding 100 quarts, which are manufactured expressly for this fruit, and cost about 35 cents each. Some of the markets call for a package holding only a bushel, for which a slat box is manu-

factured to contain that quantity, with a partition through the centre.

By the use of the improved gathering and assorting machines the cost of harvesting has been reduced from \$3.50 to \$4.50 in 1875 to from \$1 to \$2 per barrel the present season. If the grower is unfortunate enough to have any fruit not gathered when a white frost occurs, the berries will be more or less affected, which will add quite a little to the cost of harvesting.

The smaller growers dispose of their crop through commission houses in the large cities of New England and the middle States, while the large growers sell in car lots, a large part of their crop going direct to the western, southern and Pacific coast cities.

While I would not encourage indiscriminate planting of the crop, I believe under favorable circumstances and good management it is the most profitable crop grown in southeastern Massachusetts.

IRRIGATION IN HUMID CLIMATES.

BY PROF. C. S. PHELPS, STORRS (CONNECTICUT) AGRICULTURAL
EXPERIMENT STATION.

While irrigation is not a new subject, its importance in those parts of the United States where the climate is naturally humid has not been fully appreciated. In European countries, even where the rainfall is quite large, the advantages of irrigation are better known. In the older countries of the world, where the population is relatively dense and the value of lands is consequently high, every possible means that will aid in assuring full crops must be adopted. For several hundred years irrigation has been practised in the naturally moist climates of Italy, Scotland and England. The methods of artificial watering used in the old world gradually found a place in New England, and to-day many traces of old irrigation ditches may be found, especially where small streams could be easily diverted and a natural flowage be obtained. Several plain evidences of such irrigation systems on old farms in Connecticut have come under the observation of the writer. Most of these systems have been abandoned; in many cases because the farms were abandoned, and in others because the streams did not continue to give sufficient flow when irrigation was most needed. Within the last ten years there has been a new interest in irrigation and a lively agitation of the subject through the agricultural press of the east, and fruit and vegetable growers are beginning to appreciate the value of artificial watering to a greater extent than ever before. Its high value has been demonstrated in a few striking instances by some of our leading fruit growers, and these instances, together with the general interest manifested in the subject,

have led to much inquiry regarding methods of irrigation adapted to the east.

In a limited discussion of so large a subject it may be best at the outset to state briefly the reasons why irrigation is important to the New England farmer, and then to enlarge upon the different points in their order. These reasons are as follows: (1) The uneven distribution of the rainfall, and the occurrence of frequent severe droughts during the growing season; (2) the large amount of water used by all crops, and especially by most crops of high market value; (3) the large amount of water lost to the plant by leaching and by evaporation from the soil; (4) the high value per acre of many of the crops best adapted to New England; (5) the high price of lands and the changed conditions of agriculture; (6) the many small streams and ponds, by means of which irrigation may be made practicable at small expense.

Probably the first reason why farmers do not, as a rule, appreciate that irrigation has any place in New England agriculture is on account of our heavy rainfall. The average yearly rainfall (including melted snow) for Massachusetts is about 45 inches. This amount of water is ample for the needs of nearly all crops, when it is fairly evenly distributed throughout the year. But the precipitation is very unevenly distributed; much of it falls as snow in winter or as rain during the spring and fall months. Short, severe summer droughts are a characteristic of this climate. A high temperature, accompanied by drying winds, will in a week's time frequently cause our crops to wilt, and in less than three weeks the crop prospects may be nearly ruined, as a result of the absence of the water needed to keep up a vigorous growth.

In order to make a good growth, most crops need, during the three summer months, a rainfall of from 3 to 4 inches, and this needs to be evenly distributed throughout these months. During the past thirteen years the Storrs Experiment Station has had rainfall records taken in about a dozen different places in Connecticut, and these, with others made under the direction of the New England Meteorological

Society, show pretty accurately the average amount of rainfall for the summer months :—

Rainfall in Connecticut during the Summer Months, 1888-1900.

| YEAR. | June. | July. | August. | No. of Stations. |
|--------------------|---------|---------|---------|------------------|
| | Inches. | Inches. | Inches. | |
| 1888, | 1.69 | 2.05 | 5.80 | 18 |
| 1889, | 3.83 | 11.35* | 3.92 | 20 |
| 1890, | 2.96 | 4.29 | 4.29 | 17 |
| 1891, | 2.47 | 4.24 | 3.81 | 20 |
| 1892, | 2.65 | 3.80 | 4.35 | 26 |
| 1893, | 2.65 | 2.12 | 4.69 | 22 |
| 1894, | .75 | 1.55 | 1.81 | 23 |
| 1895, | 2.74 | 4.36 | 4.54 | 21 |
| 1896, | 1.78 | 3.22 | 2.71 | 20 |
| 1897, | 2.79 | 12.24* | 5.23 | 21 |
| 1898, | 2.48 | 6.24 | 5.87 | 21 |
| 1899, | 3.72 | 5.55 | 3.27 | 21 |
| 1900, | 4.32 | 2.76 | 2.03 | 23 |
| Average, | 2.68 | 3.65 | 3.99 | - |

* Omitted in averaging.

From these records it will be seen that the average rainfall during thirteen seasons for June is only 2.68 inches, for July (omitting two years of excessive rainfall) it is 3.65 inches, and for August practically 4 inches. The interesting point to be considered is that the month of June, during which most of the small fruits and many vegetables make a large part of their growth, is generally deficient in rainfall.

There are very few seasons during some part of which a drought of more or less severity does not occur. With crops like strawberries, raspberries, early potatoes and onions, a lack of rain for two or three weeks may lessen the crop one-half or more. A striking illustration of the injury caused by short droughts was seen in the season of 1895 on one of the farms in Connecticut where irrigation was being put into operation for the first time. A field of strawberries that had been set out in the spring of 1894 was on ground too high to be reached by water conducted from the storage pond. A field of the same size on another part of the farm was sprinkled from pipes laid on the surface. The

irrigated area, with only three applications of water, gave a yield two and two-thirds times greater than that obtained on the area which could not be irrigated. As a more recent illustration, which nearly every farmer will recall, we would point to the light hay crop occasioned by the spring and early summer drought of 1899, and again in 1900. In contrast to this, we can note the large hay crop of the present season (1901), occasioned mainly by the heavy rainfall of May and the early part of June.

In reference to the second reason why irrigation is valuable, it may be well to point out, first, that all growing plants are made up largely of water. Green grass or clover contains from 80 to 90 per cent of water. Many of our common fruits, such as strawberries, raspberries, peaches and pears, contain from 80 to 92 per cent of water. The importance of this to the farmer is seen in the fact that when he sells such crops he is mainly disposing of water and a small amount of mineral salts. As one prominent fruit grower puts it, he sells in his fruit many barrels of water with a little flavoring extract in it. The water held in the tissues of the plant, however, represents but a small part of the total amount needed by the plant; a very large amount is evaporated or transpired through the foliage during the period of growth.

It has been estimated that a crop of hay at 2 tons per acre, or about 6½ tons of fresh grass, will evaporate during its season of growth about 525 tons of water; that an average crop of wheat, of 720 pounds of grain and 1,500 pounds of straw to the acre, will evaporate about 260 tons of water; or, in other words, according to these estimates, every ton of green grass evaporates through its foliage during the period of growth about 81 tons of water, and in drying this ton of grass loses about two-thirds of its weight, so that one-third of a ton of hay (667 pounds) utilizes in its growth about 81 tons of water. An inch of rainfall is equal to 113 tons of water per acre. The above figures indicate that the water evaporated by an acre of grass (6½ tons) would equal about 4.6 inches. In some cases this amount of water is more than the total rainfall during

the period of time in which the crop makes its growth. These figures, of course, only represent averages. In very moist times evaporation would be checked, and in dry times it would be increased. In other words, at times when the plant uses water most rapidly there is the least available amount from the rainfall.

Professor King of Wisconsin has shown that the amount of water transpired through the foliage and evaporated from the soil by some of our common crops is as follows, when estimated on the basis of dry matter in the crop and one acre in area : —

| | |
|--|--------------|
| Dent corn, per ton of dry matter, . . . | 2.64 inches. |
| Flint corn, per ton of dry matter, . . . | 2.14 inches. |
| Red clover, per ton of dry matter, . . . | 4.03 inches. |
| Oats, per ton of dry matter, . . . | 4.76 inches. |
| Potatoes, per ton of dry matter, . . . | 4.73 inches. |

If we assume a fair yield of red clover to be 10 tons per acre (green), with 25 per cent of dry matter (equal to $2\frac{1}{2}$ tons per acre), the clover crop would use about 10 inches of water in its growth. An acre of dent corn yielding 15 tons green, with 25 per cent dry matter (equal to $3\frac{3}{4}$ tons), would use during its period of growth 10.6 inches of water. As shown in the table of rainfall previously given, the average rainfall for the past fourteen years from about twenty localities in Connecticut for the months of June, July and August is only 11.3 inches, and no account is made here of water lost by leaching.

The one important lesson that these results do point out is the large amount of water used in the growth of plants, and the need of conserving the stores in the soil or of adding an artificial supply when the rainfall is below the average. We know of no extensive experiments showing the amount of water used by small fruits, but all crops which produce a heavy growth of foliage transpire moisture rapidly. A crop like strawberries, which makes a heavy growth of both foliage and fruit in about two months, must use immense quantities of water.

The discussion of the large amounts of water used by plants naturally leads to the consideration of the third point,

or the losses of moisture from the soil. Only a part of the water which falls becomes available to growing crops. A considerable part flows off on the surface of the ground and finds its way into streams, while in the case of heavy rains quite a portion is leached away and carried beyond the roots of plants. However, in soils that are not too porous much of the water which is leached into the lower strata may find its way back to the surface soil by capillary attraction. One of the most important matters to be considered in the culture of crops is that a large and variable quantity of water is evaporated directly from the soil. The amount of this depends upon several conditions, the chief of which are the state of the weather, the kind of crop on the soil, the amount of cultivation, and whether or not the soil is mulched. In times when rainfall is insufficient for the best growth of crops the atmospheric conditions are usually such as to favor the evaporation of moisture from the soil. The amount of evaporation that takes place depends upon the amount of wind that may be blowing over the soil and the degree of saturation of the air. Meteorological data showing the relative humidity of the air indicate that on hot, dry days the air may contain as low as from 20 to 50 per cent of its water-holding capacity. Under such conditions, especially in connection with winds, the moisture evaporates from the soil very rapidly. The shade afforded by crops like grass and small grains tends to lessen the amount of evaporation from the soil, while crops which do not shade the ground as much furnish conditions more favorable for the escape of moisture.

It is a well-known fact that mulch on the soil, in the form of coarse hay, straw, etc., tends to prevent the escape of moisture. This, together with the cleaner fruit that is thus obtained, is one of the reasons for using such materials on strawberry fields. Frequent stirring of the surface soil by cultivation has much the same effect in preventing the escape of moisture as the direct use of mulch. In the experiments by the writer, on the evaporation of moisture from heavy loam and from light loam soils, part of the soils were frequently stirred at the surface, while the others were not

stirred. The average loss of moisture from the light loam soil, not stirred, was equal to $1\frac{1}{3}$ inches, while the average loss from the stirred soil was $\frac{3}{4}$ of an inch. This means that, in a given time, nearly twice as much water was evaporated from a soil left in a naturally compact condition as from the same kind of soil when the surface was mulched by frequent stirring.

The fourth argument in favor of irrigation in Connecticut is found in the high value per acre of many farm and garden crops. The following table shows the range of value per acre for some small fruits and market-garden crops, as given by practical farmers, when these crops have not been irrigated : —

| | |
|-------------------------|----------------|
| Strawberries, | \$200 to \$450 |
| Raspberries, | 200 to 400 |
| Asparagus, | 100 to 200 |
| Cauliflower, | 200 to 400 |
| Celery, | 200 to 300 |
| Onions, | 150 to 300 |

It will readily be seen that a loss of one-half on the value of some of these crops, when five or six acres are grown, would cover quite an outlay for water. Two men in Connecticut, who have made extensive use of irrigation, state that the cost of their irrigation plants was returned the first season by the increased crops obtained where water was applied.

With crops like strawberries and raspberries the increase in crop derived from irrigation represents only a few weeks' labor and a small expenditure of money. So great is the gain derived from having an abundance of water for these crops at the right time, that good profits have been obtained by the use of a road engine and force pump. In many places this form of power could be hired for a few days, and large profits be obtained from its use.

Before farming products were shipped by rail long distances, the prices obtained for the crop in any locality depended largely upon the supply in that immediate vicinity. If the season was not a favorable one for any particular crop, and the yields were light, the increased prices obtained often

counterbalanced the deficiency in the yield. To-day, however, if there is a shortage in any crop in one locality, the market, except in the case of perishable products, may be stocked from long distances away, where the weather conditions were perhaps favorable for large yields. The profits obtained by local growers are thus largely dependent on the season, and it frequently happens that the seasons of poor crops, resulting from lack of rainfall, nearly or quite use up the profits obtained in favorable seasons.

The high price of lands in New England is a fifth reason in favor of irrigation, because it is important that relatively large profits be obtained from crops, in order to cover taxes and interest. The high price of lands, together with the changed demands of our markets, have caused a complete transformation in the methods and in the leading branches of farming. The intensive system of cultivation, where market-garden crops and fruits take the lead, has almost entirely replaced the older or extensive system, where staple crops, like the cereals, were in the lead. The high value of lands where truck and fruit crops are grown, together with the high value of such crops when grown, points out the need of some form of protection against drought. Many fruit growers have adopted spraying as an insurance against damage by fungous diseases and insects; and in the same way irrigation may be considered as an insurance against drought, which often pays good dividends.

The sixth reason why irrigation should be more generally used in New England is the natural condition of the country, which favors its adoption. New England is an area of uneven surface, and is cut by many small rivers, which are bordered by fertile valleys. Into these valleys flow numerous small streams, which make a rapid descent. In many instances these streams can be diverted and carried along the sides of the valley in such a way as to flood several acres at very little cost. In other cases natural ponds can be tapped, or small dams can be constructed and the water from the ponds thus formed may be used. In cases where it becomes necessary to lift the water, large-sized rams may be used if sufficient fall for forcing the ram can be obtained.

SOME INSTANCES OF SUCCESSFUL IRRIGATION.

In the year 1895 the writer made a special study of irrigation in Connecticut, and will here give a brief description of some of the most successful plants found in operation. Probably the oldest irrigation plant in Connecticut, which is still in operation, is located on the farm of Joseph Albiston at South Manchester. The privilege was granted in 1796, the water being taken from a small stream at a point about 60 rods above the limits of the farm. There are two small irrigation plants now in use on this farm. In the older one the water is conveyed in an open ditch, and about 5 acres are watered from it. This plant was for many years used in irrigating grass, and fine crops of hay were obtained. During the past twenty years Mr. Albiston has used it mainly for watering small fruits and vegetables. Of the area watered from this canal about three acres are nearly level, having a fall of less than 5 feet in 400 feet. The water can be conveyed by means of a branch ditch along one end of this area, and then, as needed, turned down between the rows of small fruits and vegetables. About 1 acre, on quite a steep slope just below the main ditch, is thoroughly watered by seepage, the water percolating through the soil a few feet below the surface for a distance of about 4 rods from the main ditch. A second plan of irrigation on this farm was put in operation a few years ago. Near where the brook enters the farm a small dam was constructed and a pond formed. The water from this pond was used in watering about 2 acres of bottom land on the opposite side of the brook from the area watered from the main ditch. Most of the irrigated area consists of a gravelly loam, but the 2 acres of bottom land are a compact loam with a hard-pan subsoil. This area has been underdrained, and the surplus water used in irrigating is conveyed off in these drains.

Mr. Albiston has found the use of irrigation especially profitable on strawberries. Since he has irrigated this crop he rarely fails to obtain large yields, while before irrigation was employed he says partial failures from drought were common. In 1894, 32 square rods of land planted with

Crescent strawberries produced at the rate of 10,400 quarts per acre. In 1895, with a very severe drought in strawberry time, Mr. Albiston claims that his crop was the best he ever produced. The Black-cap raspberries and blackberries have each year produced exceptionally fine crops by the aid of irrigation. Potatoes have been irrigated during seasons of drought. In 1894, which was a very unfavorable season for potatoes, the crop obtained by the aid of irrigation yielded at the rate of 300 bushels to the acre. Mr. Albiston is especially fortunate in being able to irrigate on quite an extended scale at a very small cost. Under conditions of this kind, irrigation must pay a very fine profit.

The Hale brothers of South Glastonbury, extensive growers of fruits and of nursery stock, have adopted one of the most extensive systems of irrigation to be found in New England. It differs from the system just described by having the water conveyed in iron pipes for a distance of nearly 1 mile. A small brook, which has never been known to go dry, was dammed, and a reservoir thus formed. The source of the water is about 100 feet above the fields to be irrigated. Heavy iron pipes, 6 inches in diameter, were used for 360 feet from the reservoir, then a 4 inch pipe for 1,900 feet, until a fall of 50 feet was obtained, after which the pipe used was only 3 inches in diameter. The line of pipe was carried along the tops of the ridges of the farm, and at points about 200 feet apart hydrants were placed, so that water can be taken from the main pipe and be used for surface flowage or for sprinkling. It has been estimated that there is sufficient water to irrigate 40 to 50 acres, mainly by surface flowage. The contour of the land and the character of the soil are such that the water can be distributed between the rows of plants so as to give a very even distribution. Mr. Hale has used the water mainly on nursery plants and trees, upon small fruits, and, to a limited extent, upon peach trees which were producing fruit. Mr. Hale is of the opinion that the use of water on peach trees will prove profitable, during the fruiting time, in seasons of severe drought.

Another unusual system, where pipes for conducting the

water are used, is found on the farm of W. A. Leigh of Thomaston, Conn. This system is described because of the peculiar method used in distributing the water on the irrigated area. The farm is located in a narrow valley at the base of a cliff, which rises quite abruptly some 300 feet above the fields which are irrigated. Over this cliff pours a small stream which is fed by springs near the top. By building a dam across a narrow ravine, a storage pond covering several acres was formed. The water is conducted through a 3 inch pipe laid on the surface of the ground, and is used for furnishing power for a small granite works as well as for irrigating. The pressure is so great—about 125 pounds to the square inch—that a small stream runs a water-wheel, furnishing 7 horse-power. The water is used for irrigating purposes at night. Branch lines of pipe of $1\frac{1}{2}$ and of 1 inch in diameter are laid on the surface of the ground, some 50 feet apart. Short pieces of hose are attached to these lines of pipe once in about 50 feet, and the water is applied by spraying through $\frac{3}{8}$ inch nozzles. The pressure is so great that three or four of these $\frac{3}{8}$ inch streams may be kept “playing” from a single line of pipe at the same time. The water is forced to a great height, and spreads over quite an area, like a heavy shower of rain. While Mr. Leigh has about 18 acres upon which irrigation might be applied, its use has been confined to a few acres of strawberries. Beginning in 1887, he has irrigated this crop every year since. In 1895 about 3 acres were under irrigation. The water is applied about the time the plants bloom, and is continued, if needed, till near the end of the fruiting season.

J. C. Eddy of Simsbury, Conn., is making a specialty of small fruits and vegetables, and severe droughts, which have been quite frequent, have caused much damage to his crops. The farm is located near the western limits of the Connecticut valley, and the soil is mainly of a light, porous, rather sandy nature, that requires large quantities of water to successfully grow crops. A small stream, within a narrow valley, passes through the farm, and the tillage lands lie mainly upon the slopes outside this valley. As the brook is below most of the cultivated fields, some form of pump-

ing appliance seemed to be the only feasible means of making the water available, and a ram was adopted, as the most practical. For the first two or three years only one large ram was used, but the advantages of irrigation became so apparent that another of equal capacity was added. In order to get the necessary fall for forcing the ram, a canal about 40 rods in length was dug along the outer edge of the valley. From the lower end of this canal the water makes a fall of about 7 feet, through 6 inch drive pipes, and thus operates the two large rams located near the centre of the valley.

At quite an elevation above the cultivated fields, on a heavy, clayey soil, was a small pond that usually became dry in summer. This pond was enlarged by dredging and by building an earth dam on two sides. A storage pond was thus formed, with an area of about $1\frac{1}{2}$ acre and with an average depth of about 4 feet. This pond is located about 80 rods from the ram and at a height of 70 feet above it, and there is a good fall from the pond to most of the cultivated fields. Connections can be made with the pipe leading from the ram, at various points between the ram and the storage pond, and the direct flow of water can thus be used for irrigating certain areas.

Most of the irrigated fields on this farm are watered from lines of pipe extending from the storage pond. The fall from the pond is sufficient so that strawberries have been watered by sprinkling from 2 inch condemned fire hose, a flow of about 30 gallons per minute being obtained in this way. A more common method of distributing the water has been to use a series of troughs along one end of the rows of crops. The water was conducted into these by means of gates, and was allowed to flow down between the rows in little rills.

Mr. Eddy has made a specialty of strawberries, generally growing from 4 to 6 acres. The first year after his irrigation plant was installed he had 2 areas on high ground which he could not irrigate and 2 acres on lower ground to which pipes were laid for conducting the water. Early in June a drought began, which seriously injured the straw-

berry crop all over the State. At the end of the season it was found that the 2 acres which were not irrigated had yielded 150 crates (32 quarts each), while the two acres which were irrigated yielded 415 crates. After the first few days' picking, the fruit on the non-irrigated fields was much smaller and darker colored, and soon after shrivelled. The quality of this fruit was so much poorer than that on the irrigated area that it had to be sold for several cents per quart less.

Until within a few years, since the blight became so destructive, Mr. Eddy has been very successful in growing muskmelons by aid of irrigation. This crop has frequently been sold as high as \$350 to \$400 per acre. Asparagus and onions have also been grown with great success where water was applied. Cauliflower of excellent quality has been grown on this farm. This crop is one which responds readily to the use of water, and Mr. Eddy has irrigated it as often as once in five or six days, when the rainfall was deficient. The crop has generally been grown on a medium heavy loam soil, where the surface fall was only about 4 feet in 100 lengthwise of the rows. The water was allowed to flow down between the rows from a series of troughs at one end. With so slight a fall the flow was very gradual, and the water would gradually soak laterally underneath the rows. The cauliflower headed earlier than usual where irrigation was practised, and the crop has generally sold for about \$400 per acre.

EXPERIMENTS WITH IRRIGATION ON STRAWBERRIES.

In June, 1895, the Storrs Agricultural Experiment Station began some experiments on the farm of Mr. Eddy, for the purpose of studying the effects of irrigation on the quantity and quality of strawberries, and to ascertain some facts regarding the profits to be obtained from the use of irrigation. A section of about 2 acres was chosen from a field of strawberries. The soil appeared to be nearly uniform, and the conditions were favorable for applying the water. The field had been set to strawberries in the spring of 1894. The Haverland was the variety used, with every

fourth plant in the row a Jessie, the latter being used for fertilizing. The plots were laid out 115 feet long and 12 feet wide, three rows to a plot, two plots being irrigated and two not. Two rows were left between plots, which were not included in the experiment, in order to thoroughly separate the irrigated from the non-irrigated sections. The plots were irrigated as often as seemed necessary to get good commercial results.

Comparative Yields, in Quarts, on Irrigated and Non-irrigated Plots of Strawberries, 1895.

| | |
|------------------------|--------------------|
| | PLOT 1, IRRIGATED. |
| | |
| PLOT 2, NON-IRRIGATED. | |
| | |
| | PLOT 3, IRRIGATED. |
| | |
| PLOT 4, NON-IRRIGATED. | |
| | |

The yield on the two irrigated plots was at the rate of 5,318 quarts per acre, and on the two non-irrigated at the rate of 2,083 quarts.

Water was used on the irrigated plots on June 10, 15, 18 and 20. The water was applied by means of 2 inch hose from a 2½ inch iron pipe laid on the surface of the ground. The size of the stream and the force of the water was sufficient to give 30 gallons (about 1 barrel) per minute. At this rate of flow one man could sprinkle about 1 acre per day. The ground was given a thorough wetting each time.

On June 24 the writer visited the fields, and made the following notes: "Plants on non-irrigated plots are drying badly; leaves shrivelled, and many dry and dead; fruit small, dark-colored when ripe, and shrivelled and seedy; fruit looks over-ripe when picked. The darker color is probably due to the increased sunlight that the fruit gets, owing to the shrivelled condition of the plants. Plants on the irrigated plots look fresh and vigorous, fruit large and abundant, much green fruit continuing to develop; size of

berries large, color bright; fruit not quite as sweet as on the non-irrigated plots. Should judge the fruit from irrigated plots would sell for 2 to 3 cents per quart more than that from non-irrigated."

Mr. Eddy found that the fruit from the non-irrigated plots had to be sold for an average of 9 cents per quart, while that from the irrigated areas brought 11 cents. At these rates per quart, the fruit on the irrigated plots sold at the rate of \$584.76 per acre, and that on the non-irrigated at the rate of \$187.47 per acre,—a difference of \$397.29 per acre in favor of irrigation.

It will be readily seen that even with two acres of strawberries the increased returns obtained by the use of water furnished quite a sum towards covering the expense of an irrigation plant.

SUGGESTIONS REGARDING IRRIGATION.

The contour of most of the land of New England is such as to readily admit of the conveyance and application of water for irrigation. Streams, ponds and springs are common, and, except in cases of severe droughts, furnish an adequate supply of water. Many crops, like strawberries, raspberries and early vegetables, need irrigating, if at all, early in the season, when the supply of water is often sufficient, while perhaps later in the season it would not be. Much of the land that would be improved by irrigation is in valleys near to streams and ponds, which in many cases are high enough to give a moderate flow on the areas below, so the cost of getting the water would be merely nominal. The soils used for many of our most profitable crops are generally light and porous and leach water readily, but are just the kind of soils that most need irrigating; while our best money crops, such as small fruits and vegetables, are heavy users of water. There is no need of drainage in connection with irrigation on soils of this class, as is often the case where the surface soil is compact.

Means of making Water Available.—The sources of water for irrigation in New England are natural or artificial ponds, streams and springs, and in some cases wells. In many

cases ponds are so located that water can be conveyed from them to fields on lower ground by means of open ditches, the expense depending upon the distance and the character of the ground to be passed through. This often is the cheapest method for securing water. When the supply is large, the loss of water occasioned by soakage from the ditch or evaporation is not of serious consequence. The fall of many of our small streams is so great that by building a small dam the water may be turned from its natural course and conveyed in ditches along the outer edge of the valley, and then allowed to flow over the surface of the fields back to the natural stream.

Rams.—In many places the source of supply is below the fields to be irrigated, and the water can only be made available by some pumping device. The cheapest sources of power are water and wind, although steam or electricity may be profitably used where the water is wanted only for a short period of time. A ram, under many conditions, is the best power. As only a small part of the water that is needed to operate the ram can be pumped, the supply must be quite large and the ram of heavy capacity. If the water is lifted over 40 or 50 feet high, the strain on the ram is quite severe, and all parts must be securely and strongly made. But few styles of rams manufactured in this country are powerful enough to supply water for anything but small areas, perhaps 3 to 6 acres.

Windmills.—If wind is the form of power to be used, the mill should be constructed of the best materials, and be strong and secure in all its parts. Cheap forms of mills should be avoided in all cases. The best steel mills are the cheapest in the end. The mill should be located on high ground, so it will “catch” the wind from all directions, and the place of storage should be sufficiently above the fields to be irrigated to give a good fall. The average velocity of the wind in New England is about 12 miles per hour. A 14 foot wheel will do good work with a wind of 10 to 15 miles per hour. Of course the movement of the wind is very irregular, but there is usually sufficient to furnish power for pumping water for 3 to 6 acres, by having a

large storage tank. Wheels of large diameter are to be preferred, in order to utilize light breezes.

Steam Power.— When water is wanted for a short time on one or two crops which generally give good profits, some form of engine and pump may be economically used. The Wisconsin Experiment Station has watered a variety of crops in this way, and has shown this method of irrigation to be a profitable one. For crops like strawberries, raspberries, and some vegetables which give large returns per acre and require water only for short periods of time, steam may be advantageously used as a source of power for pumping. On many farms a portable engine might be profitably rented for a few weeks during the strawberry season. This is a time when farm engines are seldom wanted for other purposes. Naphtha or gasoline engines of 5 to 6 horsepower are economical of fuel, can be easily operated, are of lighter weight than coal engines, and as a source of power they are worthy of careful consideration.

Application of Water.— The oldest method of distributing the water over the fields to be irrigated is by means of small ditches. These can be made by turning a furrow with a plow along the highest part of the field to be watered. By having a number of lines of these ditches parallel to each other along the slopes of the land, the water may be let out on the lower side of the highest ditch and distributed over the land between this and the next ditch, while the second ditch will catch the surplus water. A man with a hoe removes obstructions, and directs the water by opening small water courses. With a little attention, the water can be made to touch nearly all parts of the field.

For crops like strawberries, when the water must be run between the rows, these should extend up and down the slope. Only a slight slope is needed to give free movement to the water; from 3 to 6 feet for every 100 feet is better than a greater fall. With a heavy fall, and especially if the soil is sandy, serious washing will often result. In case mulch is used on strawberries, it is found to interfere badly with the flow when the water is applied by surface flowage. If mulch is thought to be necessary to keep the fruit clean,

water should be applied freely just before the picking season begins, and then the mulch be applied. Wooden troughs may be used for distributing the water. These are made of rough boards, 10 and 12 inches wide, nailed together V-shaped, and are supported on stakes across the upper ends of the rows in such a way as to give a slight fall across the field. By means of small auger holes the water can be made to flow out between the rows. With small strips of tin, gates are made over these holes so that the amount of flow can be regulated.

If the water supply is limited, iron pipes may advantageously be used in distributing the water to the points where needed. The water may either be allowed to flow from these over the surface or be applied by sprinkling. Unless the fall is very great (100 feet or more), these pipes should be at least 2 inches in diameter. Condemned fire hose 2 to 3 inches in diameter can be bought in most of our large cities, and if the fall from the reservoir or tank is 50 feet or more, a heavy spray can be obtained by their use. A flow of 25 to 40 gallons per minute seems to be necessary in using iron pipes and hose, in order to apply the water as rapidly as is desirable for strawberries.

In case a fall of 200 to 300 feet can be obtained, and the water can be conducted in pipes, it may be applied by means of lines of perforated pipes laid on wires over the fields; or, if the pipe is laid beneath the ground, a series of small nozzles may be placed at intervals along the lines of pipe, and the water be applied in the form of a spray.

POULTRY KEEPING AS A PRINCIPAL FEATURE OF DIVERSIFIED FARMING.

BY JOHN H. ROBINSON, EDITOR OF "FARM POULTRY," BOSTON, MASS.

In the issue of the crop report for August, 1900, Dr. A. A. Brigham very concisely and plainly presented the elementary facts in regard to poultry keeping on the farm.

When I was asked to prepare an article for this issue on some supplementary line, two good reasons for discussing the relations of poultry keeping and other branches of agricultural work at once presented themselves to my mind. In the first place, the need of such discussion — the advantage to farm poultry keepers of a proper presentation of the facts in the case — has been very forcibly impressed upon me by what I have seen in the course of a series of visits to poultry farms, extending over some four years' time, and including farms in many sections of the country, but mostly in eastern Massachusetts and Rhode Island. In the second place, I had recently given a great deal of thought to this subject, and therefore felt better able to present it at short notice. Whether my judgment on this last point was good, or the reverse of good, the reader must determine.

POULTRYMAN OR FARMER POULTRYMAN.

It has been a serious and too common error of poultry farmers in recent years that they have made themselves poultrymen, and nothing more. Many have gone even further in the wrong way, and have tried to make of themselves specialists in a single branch of poultry keeping. With a few notable exceptions, those who have limited their effort to narrow special lines have not made their operations with poultry financially successful. Single, separate

branches of poultry culture have rarely been made profitable as all-year-round exclusive occupations. It is worth while to note and remember this, because some very plausible arguments in favor of extreme specialization in poultry culture are sometimes advanced, and their partial presentation of the facts is often so alluring that many people are persuaded into doing what is soon found to be unprofitable.

When a man who knows little or nothing about poultry and as little about growing farm crops writes to ask me if it is possible for him to stock a farm with poultry, conduct it as a poultry farm, and at the same time produce on the farm the food for the poultry, I answer most emphatically that it is not, — not for him. When a good poultryman who is no farmer asks a similar question, I do not feel warranted to encourage him to try to do more, at first, than grow a part of the food for the fowls, preferably such things as cabbage, mangels, turnips, grain to be fed in the sheaf, not attempting the growing of grain crops on a large scale until he is more sure of his ground. But the case of the farmer engaging in or extending operations in poultry keeping is quite different. He is generally somewhat of an expert in crop growing, and, even though he may not have given special attention to poultry culture before, is apt to be pretty well grounded in general methods of caring for live stock. He, therefore, is in a position to begin at once to combine poultry keeping with his other farming.

METHODS OF POULTRY KEEPING COMPARED.

It was a surprise and something of a disappointment to me, coming from a western State, to find so many of the farmers of New England, who were giving special attention to poultry, adopting the back-yard methods of the city poultry keeper, thus throwing away some of the positive advantages the farm offers the poultry keeper, and taking instead the doubtful advantages of modern intensive methods of poultry culture. I would not be understood as decrying these intensive methods. They are good methods, — under some conditions they may be the best methods: but they are not — except when greatly modified (that is, when less intensive) —

good methods for the farmer, and I do not think they are the best methods of poultry keeping. And, while it is true that many special poultry growers have succeeded with poultry, while neglecting the crop-producing possibilities of their farms and buying practically all food for their fowls, the experience of those who grow a part or all of their food convinces me that such a combination is to be the favorite combination including poultry keeping. I find, too, that a majority of the progressive poultry farmers of my acquaintance are working toward this combination.

The possibilities in this combination will, perhaps, come out more clearly if we review briefly the conditions of poultry culture in that wide area of the central west which produces a large surplus of poultry products, and indicate some of the most striking points of contrast between western farm methods and the intensive methods which obtain in towns everywhere and on many eastern poultry farms. There are many other eastern farms where distinctively *farm* methods are in vogue, but in the west we find them more nearly universal, and find almost nothing of the intensive method outside of the towns.

The farm flock of laying hens ranges in numbers from 50 or 60 to 250 or 300, 100 to 150 being perhaps the usual numbers for average farms. The annual crop of chickens will range from 100 to 150, up to 400 or 500, 200 to 300 being perhaps a fair average.

The points of present interest in regard to the handling of these flocks are: That the labor of caring for them rarely interferes to any serious extent with the other work of the farm, being performed either by women, in the intervals taken from housework, by children, or by the men as a part of the "chores" (the stock is not allowed to become so numerous that the care of it becomes burdensome); and that the fowls, both old and young, pick the greater part of their living, subsisting mainly on food obtained by foraging, and which would otherwise be wasted. What salable food is fed them is not expensive, the actual cost of it being only the cost of production.

Under such conditions the receipts from poultry products

are almost clear profit. In many cases, considering that the eggs and poultry consumed by the family pay for salable food consumed by the fowls and for labor, the total receipts are profit. In few cases is there any cash outlay worth mentioning on account of the poultry : so that, even with a low rate of production of eggs and with heavy losses of chicks, there is not a loss which the poultry keeper feels, — a loss which drains his pocket-book.

Compare and contrast such conditions with those which obtain under intensive methods, where as many as 400 hens may be kept on an acre of land, and where five to ten acres is considered ample room for several thousand head of young stock. In the case supposed the poultryman buys all food. The consumption of food by the laying hen goes right on, whether she is producing eggs or not. A few thousand head of young stock may consume hundreds of dollars worth of food before any of them are ready for market. Under such circumstances the poultryman must either have capital sufficient to carry his stock through unproductive periods, or must work and plan to secure in some way sufficient income to pay current expenses. Failing at these points, he must ultimately go out of the business. If he has stock enough to take all his time, that prevents his making a few dollars elsewhere when the dollars from the poultry are not coming in, thus making him wholly dependent upon his poultry for an income and a living. His crowded stock requires, proportionately, far more labor to keep it healthy and productive than does stock kept under the half-natural conditions on the general farm. It must produce better to pay for the food he buys for it and for his labor, and he must strain every nerve to avoid losses, for every chick or fowl lost must directly or indirectly be paid for in cash. No exclusive poultry business could stand such a percentage of loss as occurs on the average farm.

With sufficient capital and ability, many persons have made a success of poultry keeping by intensive methods. No doubt some succeed this way who would not succeed if they attempted to combine poultry keeping with farming. But that does not prove that it is the best way or the most

profitable for the greatest number of poultry keepers; and the present evident reaction from intensive methods furnishes good evidence that those who have tested them have often found them wanting. Poultry keeping readily enters into combination with almost every branch of agriculture, and the attempt to keep it entirely separate generally does violence to its development along natural lines.

LEAKS IN EXCLUSIVE POULTRY KEEPING.

It has been said that poultry keeping is readily combined with almost any branch of agriculture. It may also be said that poultry keeping naturally combines with several branches of agriculture. When one undertakes to limit his effort to an exclusive poultry business, he is likely to find that there are some very practical objections to that course, and that circumstances combine to force him to engage in several side lines of work.

Fowls must have shade. Fruit trees and vines planted in the yards will furnish shade, and will grow and bear better than under almost any other conditions. So, almost without thinking about it, many poultrymen drift into fruit growing on a small scale.

A large stock of fowls makes in the course of a year a great deal of very valuable manure, the greater part of which is lost to the poultry keeper, unless applied to crop-producing land on the same farm. The night droppings, which can easily be collected and kept in condition to sell, constitute but a small part of the manure made. The most of it falls either on the earth floor of the poultry house, there to be mixed with the sand or earth of the floor, or with this and the broken leaves, straw or other material used for litter, or is deposited on the ground on which the fowls run outside. None of this manure is salable, but every bit of it can be utilized. Moreover, if it is not utilized, it will sooner or later poison the land wherever deposits of it are very abundant, making it unfit for poultry and often causing disease and loss to such an extent that the poultry ceases to be profitable. Whether a poultry keeper makes use of the manure or not, he must take care

that it shall not remain in such places or in such condition that it is a danger and a menace to the health of the fowls. The rough of the droppings on the floor of the poultry house must be removed at frequent intervals, and once a year, at least, the earth floor must be removed to a depth of four or five inches, and renewed. Labor is required to thus renew the floors of the houses yearly ; and if the soil taken out is not utilized, or is used simply as so much rubbish to fill a hole or ditch, the cost of this labor must be paid for directly out of the cash receipts. If this soil, saturated and thoroughly mixed as it is with hen manure, can be applied as a top-dressing to grass land, its value for this purpose will more than compensate, in the increase of the next year's hay crop, for all the labor of renovating the floors. Of course this soil is useful for many other crops, but I have mentioned this one as that to which it is most generally applied. I have seen on farms in this State pieces of mowing land heavily dressed year after year with hen manure and soil from the poultry houses and yards, when the annual cut was sometimes as high as four and five tons per acre.

The droppings deposited outdoors are to be considered next. When hens are kept in small yards, these have to be treated much as the floors of the houses are. Even with much larger yards, something must be done to purify the soil. If the yard, though not very small, is not large enough to be kept permanently in grass, frequent spadings are necessary to keep it in habitable condition ; but these mere spadings or stirrings of the soil, while they improve it, do not put it in perfect condition. Nothing will do that like growing a crop on it. If the yard is large enough to be kept in permanent sod, but still so small or so heavily stocked that every part of it is trampled over by the fowls many times a day, the condition is not much better ; the sod, undisturbed from year to year, becomes poisoned as the bare earth would, and the common result is a slow poisoning and slow but sure deterioration of the poultry stock, even when conditions are not bad enough to produce malignant disease.

In the localities in this State where soft roasters are grown extensively for the Boston market, intensive methods are necessarily pursued; but the strictest care is taken to prevent poisoning of the ground over which the chickens run each year. After a crop of chickens is all sold, — the last of them generally going to market in July, — the fences are all removed and the whole plot of ground occupied by the yards is plowed deep and sowed to winter rye. Thus the ground is thoroughly cleansed each year, and at the same time the work of purifying it is paid for by the crop of green rye, which furnishes green food to the next crop of chickens.

So far we have not considered the manure from the young stock grown for laying and breeding purposes. A considerable part of this, deposited in coops, brooders and brooder runs, must be handled like that of the general stock collected from the houses or deposited in the yards. But, to secure the best possible development of the growing chicks, they must be given good, clean range from the weaning age until maturity. It is possible to give them such range on ground that is not productive. They will do well on light sandy or gravelly soil that is washed clean of their droppings by every heavy rain. They will do well on a field so full of boulders that it can neither be tilled nor mowed. But the loss of manure under such conditions is considerable, and it is an absolute loss. Besides, while chicks do well on such land as has been described, they do as well or better on good grass land; and, as chickens grown for stock or laying purposes are rarely large enough to be distributed over a range in roosting coops until about haying time, it is possible to use the same land to grow a crop of grass, and after that as a range for chicks, and thus utilize on this land every bit of the manure they make during the season, it being spread thinly and quite evenly on the land as the chickens range over it. Running chickens on this land prevents cutting a second crop of grass the same season; but as cows and chickens combine nicely, and as, if the chickens are as well spread out as they should be, they do not spoil the grass for pasture for the cows, to use the mowing land for pasture for cows and chickens after the first crop is off pays better than

to attempt to secure a second cutting. Such, at any rate, is the testimony of many who have tried both ways.

There are many farms where a few acres of mowing land heavily manured with hen manure give a very abundant crop of hay each year; but I want to mention one in particular, where, largely through the use of hen manure (though it is a combined dairy and poultry farm), applied both by the fowls themselves and in bulk by the farmers, the cut of grass has been enormously increased in a few years. When the present owner took this farm of about 100 acres, some seven years ago, it would not cut one ton of hay. It had been a very much neglected if not literally an abandoned farm. Last year it cut forty tons of hay, and within a year or two, as additional portions of it are brought into a high state of productiveness, the farm will cut a hundred tons of hay per annum.

COMBINATION ALMOST INEVITABLE.

But grass, though a profitable crop, and made more profitable through the agency of the hens, is not a crop that can be used to any great extent as poultry food. Some clover rowen, cut in good season and nicely cured, the hens can use to good advantage; but it is hardly worth while to attempt to use for poultry food any but clover or alfalfa hay, and a small piece of ground will furnish enough of either of these for quite a large stock of poultry. So it becomes a question, to be decided by each farmer according to his circumstances, whether it will be more profitable for him to have as much as possible of the farm in grass, sell hay and buy grain, or to endeavor to grow as much as possible of the grain needed. Or, to put the question the opposite way and from a farmer's rather than from a poultry keeper's standpoint: supposing a farm a considerable part of which is suitable for grain growing, will it pay better to sell the grain, or to feed it to stock on the farm?

I think that it is to-day a commonly accepted principle in farming, that, to maintain or increase the crop-producing capacity of a farm, as much as possible of the produce must be fed on the farm, the nutritious portions converted into produce of small bulk and easily handled, and the residue

returned as manure to feed the land. Assuming that a certain farm is to be conducted on this principle, the next question to be decided is: what kind or kinds of live stock shall be used in converting the bulky produce of the land into more condensed forms, of greater value and more easily handled?

There have been many farmers in this section who, when they became interested in poultry, and found it, perhaps, more profitable than anything else they had tried on their farms, gave all their attention to the poultry, to the neglect, if not to the entire abandonment, of every other branch of farm work. So far as my observation goes, such men have generally found it necessary to retrace their steps, and gradually get back to a combination in which some other branches of farm work were quite equally important with poultry. The reasons which bring them back to more diversified farming have already been stated. They are the same as those which suggest to a poultryman who is not a farmer, after he has had experience in watching some of the leaks in an exclusive poultry business, the advisability of extending operations into side lines which will take care of those leakages, even if to do so requires some curtailment of the principal, or poultry, business. The farmer, because of his previous training, is likely to see and act more quickly in such cases than another man would.

When one branch of the work on a farm is proving more profitable than others, there is a temptation to develop it at the expense of the others. This, to be sure, is in the line of natural development, but even naturally things over-develop sometimes; and in such cases we have to be careful to avoid developing a favored line of work so fast and so far that the change of conditions thus created reacts on the profits from this line of work. For such over-development not only means failure of income from the lines of work abandoned, but it means that there will soon be a reduction of profit, as compared with cost and labor, in the overdone branch itself. By overdoing one branch, that balance of interests, the proper adjustment of which means the maximum of profit from the minimum of investment and labor, is disturbed.

TWO ILLUSTRATIONS.

Returning to the question of the poultry farmer's growing his grain, or the grain-growing farmer feeding his grain to poultry, I want to tell a little about two farms which I have visited within a few months, visiting them within a few days of each other, which furnish excellent illustrations of the matter under consideration, one from the farmer's, the other from the poultryman's, point of view.

The first is a farm of 200 acres, in New York State. For a number of years this farm was run by its present owner and a brother as a grain and grass farm, and was run at a loss. In the effort to make the farm pay, they took up Holstein cattle, and after a few years began to find the balances on the ledger going to the right side. At some time during the early experience in making a stock farm the other brother withdrew, leaving the one who still owns it in full control. Becoming interested in poultry and finding it profitable, this man built up a large poultry plant, and increased the poultry stock until last winter he had at the beginning of the season about 3,000 laying hens. The poultry plant has been some six years or more in developing, and in that time the stock of cattle has been very much reduced; it has, indeed, been reduced too much; and the owner of the farm told me that, while he considered it more profitable to feed his grain to the fowls than to sell it or use it in any other way, he had found that to use his farm and all its produce to best advantage he would have to carry a larger herd of cattle and some sheep, which, with the horses needed for the farm work, would use a part of the grain, and what hay, straw and pasturage could not otherwise be used to full advantage. It may interest those who read this to know that, though this man paid for his farm with Holsteins, he is now going into Guernseys.

The other farm alluded to is located in New Jersey, and contains about 100 acres of good land, practically all under cultivation. This farm has for many years been owned by a city business man, and until last year was occupied by a tenant farmer. A son of the owner of the farm has within a few years built up on the farm quite a large and profitable

poultry plant, following at first the intensive method a little more closely than is advisable on a farm, and using but a small portion of the land for poultry. But as the poultry business grew, the need of abundance of room for the growing stock and the advantages of combining poultry keeping and the growing of crops which could be used for poultry food became so apparent that when recently the tenant's lease expired, it was not renewed, and the owners are now operating the entire farm themselves, hiring competent farm hands to attend to the crops, the poultry being still the special charge of the young man who built up the poultry plant.

These two farms (I wish every reader of this article could see them both) furnish the most noteworthy illustrations of combined poultry keeping and crop growing I can at present call to mind, though I could cite scores of cases where similar combinations are made on a smaller scale.

The point is to strike the proper balance between the different kinds of work and make them fit well together.

THE LABOR QUESTION.

The most difficult matter to regulate, when poultry keeping is combined with other farm lines of work, is the labor. When the pressure of work in two or three different lines is greatest at one season of the year, something is likely to be neglected. As a rule, the branch of work neglected is that which seems of least importance, or in which the worker feels less certain of his ability to get the results desired. Thus, an expert poultryman, trying to do some farming, who finds that he cannot handle all the work he has undertaken, usually neglects the farming; while a farmer is more apt to make sure of the crops, to the neglect of the poultry. Now, I do not feel that I am at all competent to tell any one who gets into such a predicament how to handle the crops to get as much as possible out of them with the least possible expenditure of labor; but I can point out some ways for lightening the burden of poultry work. What I have to say will not, perhaps, be of much immediate value to one involved in a tangle of overwork. It is more in the way

of telling how to keep out than how to get out of such difficulties. The key to the problem is found in the right combination of common farm methods and intensive methods of poultry keeping. By the farm method, the hens come very near taking care of themselves: by the intensive method, the hens do almost nothing for themselves, — all depends upon the keeper. By striking the golden mean between the two extreme methods, a farmer is able to handle a flock of poultry large enough to consume and profitably convert into eggs and meat a considerable part of his farm produce, and to handle such a flock without allowing that work and farming proper to interfere. Three things will be found of prime importance in bringing about this result: the hens must be kept in larger flocks than is usual with the intensive method, they must be given more yard room, and the system of feeding must be such that feeding will take as little time as possible.

It has long been taught by authorities on intensive methods of poultry culture that the best results in eggs were obtained from small flocks, and that, for some unknown reason, hens would not lay well when kept together in large numbers. As a result of this kind of teaching, it has been and still is the practice, almost general among those who make special efforts to make poultry profitable, to divide the stock into small lots, containing from 12 to 25 or 30 hens each, the smaller number being regarded as more desirable for actual results, though, because of the increased cost of housing and yarding, a little larger flock is said to be, on the whole, more profitable. I cannot, within the limits allowed this article, present a mass of facts bearing on this subject, which facts would show positively, by the experience of many different poultry keepers, that the keeping of hens in large flocks is not necessarily a bar to good egg production. A little further on I will mention two cases in point. For the rest of the evidence I must ask the reader to take my word for it that laying hens can be kept in large flocks and yet lay as well, so far as can be ascertained, as they would lay under any circumstances. There are particular reasons for not keeping breeding stock in

large flocks, but these have nothing to do with the number of eggs produced. It is true that the greater number of poultry keepers get better egg yields from small flocks than from larger ones; it is also true that some poultrymen get as good egg yields from large flocks as are obtained from small ones, except in very exceptional cases. What investigations and observations I have been able to make have convinced me that the general reason for poor results from large flocks is underfeeding. Certain it is that all those I know (altogether there are a good many of them) who get good results from large flocks are liberal feeders, — almost extravagantly liberal, quite a number of them keeping food by the hens all the time.

Much less time is required to care for 200 hens in two flocks of 100 each than to care for the same number in flocks of 12 to 30 each. One of the most successful small poultry farmers I know keeps 600 to 700 hens in flocks of about 100 each, each lot occupying its own house, but all running in the same field. One of the men who is most successful in getting winter eggs keeps as high as 500 hens in a single flock, and in the same house. Such facts as these effectually disprove the theory that there is something in the nature of the hen which prevents good egg production from large flocks, and puts the responsibility where it belongs, — with the keeper. He must learn to get eggs from the large flocks if he wishes to work to best advantage. It is simply a question of feeding the large flock right, — of seeing that they get enough to eat.

Close confinement is irksome to most fowls. They fret under it, because their movements are too restricted. Hence fowls in close confinement, in small yards, require a great deal of attention, with special provision to keep them occupied and busy. Give the same fowls room enough, so that the restraints placed on them are not oppressive, and they are contented, keep healthy, and produce well without so much attention from the keeper.

An objection often made to large yards is the cost of fencing. This objection loses much of its force when applied to large flocks and large yards, for the larger the

yard the lower the fence needed, and thus the relative cost of fencing is much less for hens in large than for hens in small flocks.

When hens have abundant room, feeding is a much easier matter than when they are closely confined. "Little and often" is the feeding rule of most intensive poultry keepers. Hens that have room in which to be contented, — room to roam about without coming to a fence every few steps, and perhaps opportunity to pick a small part of their living, can be fed, and fed right, by giving food only twice a day; and if it is necessary to do so, it is possible in such cases to arrange so that all the feeding can be done at one time, the soft food to be eaten at once and the grain through the day as the hens want it.

In feeding young chickens the same thing is true. With abundance of room they require far less care. The best arrangements I have ever seen for growing young chicks have been on farms of breeders of choice exhibition fowls, who want to give their chicks the best possible chance to grow into fine specimens, and endeavor to aid nature in every possible way. I visited such a farm not long since, where the broods of chicks were distributed at good intervals along the edges of the mowing fields. The coops were placed out this way quite early in the spring, as fast as the chickens were hatched. The fences were lined with vines and shrubbery, making a fine shade for the chicks. Before the grass was ready to cut a narrow strip was mowed with a scythe along the edge near the coops, giving ample room for the chicks while small. Then after the hay crop was taken off the growing chickens had all the land to themselves. Such an arrangement as this is possible anywhere, and for ordinary stock it is possible to care for chicks in this way with very little work. Food and water can be by them all the time, and with opportunity and the disposition to exercise, with plenty of green stuff and bugs and worms to be had, I have seen chicks thus grown on cracked corn alone and with little labor.

PARTNERSHIP ARRANGEMENTS.

So far we have considered our subject on the supposition that one man has to do all the various tasks. When a man can have help from some members of his family, or when his business justifies the employment of another man, or when two or more men work together as partners, the problem is very much simplified, because it is easier for two or more persons to divide certain labors than for one person to divide his time for a variety of tasks or occupations. The ideal condition of diversified farming which includes poultry keeping is a partnership, in which each member of the firm or of the family looks after a particular branch of the work, and each helps out others in emergencies. It is not necessary to attempt an enumeration or specification of the possibilities of arrangements of this kind. Poultry keeping is an employment in which both women and children can engage to advantage, and at the same time it is one which, if conducted on a large scale, is worth a man's time and strength and resources.

Rightly managed, it will always, as far as we can now see, be a profitable specialty for most farmers in the area contiguous to our great sea-board cities. We can conceive of conditions under which the western farmers, with their facilities for producing poultry products abundantly and cheaply, might make poultry growing in the eastern States unprofitable; but we cannot find reasons for supposing that those conditions will ever materialize, and if the eastern farmer will make good use of his opportunities and advantages, he need not fear western competition in poultry and eggs. The bulk of the best trade in the lines in which he can operate to best advantage will always be his own. The principal consideration with him should be to keep the cost down as low as is consistent with good quality, and to avoid leakages and losses of all kinds. The selling price takes care of itself. The cost price is more under control of the producer; and hundreds of producers to-day are finding that the best profit from poultry is derived from poultry keeping as a leading feature in diversified farming.

ELEVENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

JANUARY 15, 1902.

REPORT.

The membership of the Bureau has remained unchanged during the past year. The administrative work has continued in the same hands as heretofore. This officer the past year concluded ten years' service in the work of the Bureau; the present report, however, is the eleventh, because the Bureau began its existence in September, and the first report was for part of a year, — the last four months of 1891. No new chemists or regular inspectors have been engaged during the year. As previously reported, special inspectors are employed temporarily from time to time in emergencies, when a face unfamiliar to the dealers in counterfeit or adulterated products is needed.

The past year has been a record breaker, as far as tangible or reportable results is concerned. We have more to show in evidence secured, in court cases and in educational work than has been accomplished in any previous year of the Bureau's history. But we do not speak of this in a boastful spirit, or with unalloyed satisfaction. The fact that we have secured an unusual amount of evidence of law breaking presupposes the *existence* of an unusual amount of law breaking, and that is not pleasing to contemplate. Just as faithful work was accomplished, we have every reason to believe, in 1897, when we had only 27 cases in court, as in 1901, when we had 252. The conditions would be more satisfactory in a broad way if there was such a law-abiding spirit in the community, or if the law had such a deterrent effect, that efficient inspection could find no evidence on which to put cases into court for prosecution. But under prevailing conditions, when the love of unjust gain leads grasping men to push the sales of dishonest products, we feel some satisfaction at what we have accomplished by way of punishing such acts. We are sorry to add that the desire to sell fraudulent products is such that we could have done much more, and

beaten our own record, large as it is, were it not for one thing, and that is, the lack of money. The greatest hindrance to our work has been our limited appropriation. It costs money to get evidence and to prosecute cases. The amount of effort we can put out in the interests of honest food products is governed by the amount of money at our disposal. We are public servants; does the public want us to do more in the future than we have done in the past, — then we must have more to do with. Bricks cannot be made without straw. The possibility of getting 80 to 100 per cent. profit out of the consuming class by the dishonest sale of certain food imitations is a constant stimulus to push the dishonest business. Is it desired that we should be able to meet the increasing efforts in this direction? We could use \$3,000 more to excellent advantage in the interests of pure and honest dairy products.

Statistically, our work for the past year may be summarized as follows : —

| | |
|--|-------|
| Inspection of places in which dairy products or their imitations were sold or stored, but where the law seemed to be complied with, and no samples were taken, | 1,757 |
| Samples taken, real or imitation butter, | 721 |
| Samples taken, milk or cream, | 189 |
| Samples taken, cheese, | 1 |
| Cases in court, | 252 |
| Meetings addressed, | 20 |

This is 145 more inspections, 85 more samples taken and 74 more cases in court than the previous year. In court cases we reported that 1900 was a record breaker, with 178. The past year we exceeded that figure, as stated above, by 74.

The court cases were brought under the following laws : —

| | |
|---|-------|
| Imitation butter, anti-color law, | 88 |
| Imitation butter, hotel-restaurant law, | 127 |
| | — 215 |
| Milk, adulterated, | 10 |
| Milk, under standard, | 20 |
| | — 30 |
| Obstructing an officer, | 6 |
| Assault and battery, | 1 |
| | — |
| Total, | 252 |

The cases in court resulted as follows : —

| | |
|------------------------|-----|
| Convictions, | 218 |
| Acquittals, | 17 |
| Defaulted, | 2 |
| Nol pros, | 15 |
| | — |
| Total, | 252 |

This is almost 1 case a day for each working day. It is no inconsiderable task to receive and pass upon the evidence in 252 cases, to make the complaints, to take charge of the cases in the district and police courts, to keep track of such as are appealed, to follow them into the superior court, and to do the necessary incident clerical work.

BUTTER, — NORMAL.

The butter market has been in a fairly healthy condition during the past year. The creameries of the State have, on the whole, done a satisfactory business, though producers have been hampered by an increased cost of production, owing to the higher cost of grain. The following table shows the extreme quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last six years : —

| | 1901. Cents. | 1900. Cents. | 1899. Cents. | 1898. Cents. | 1897. Cents. | 1896. Cents. |
|----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| January, | 25.0 | 29.5 | 21.0 | 22.5 | 22.0 | 26.0 |
| February, | 25.0 | 26.0 | 24.0 | 21.5 | 22.0 | 24.0 |
| March, | 23.0 | 27.0 | 22.5 | 22.0 | 23.0 | 24.0 |
| April, | 22.0 | 21.0 | 21.0 | 22.5 | 22.0 | 22.0 |
| May, | 19.5 | 20.5 | 19.0 | 18.0 | 18.0 | 17.0 |
| June, | 20.0 | 20.5 | 19.0 | 17.5 | 16.0 | 16.5 |
| July, | 20.0 | 20.5 | 19.0 | 18.5 | 16.5 | 16.5 |
| August, | 21.0 | 22.5 | 21.5 | 19.5 | 19.0 | 17.5 |
| September, | 22.0 | 22.5 | 23.5 | 21.0 | 22.0 | 17.5 |
| October, | 21.5 | 22.0 | 24.0 | 21.5 | 22.5 | 20.0 |
| November, | 24.0 | 25.0 | 26.5 | 21.0 | 22.0 | 21.0 |
| December, | 24.5 | 25.5 | 28.0 | 21.0 | 23.0 | 23.0 |
| Averages, | 22.3 | 23.5 | 22.4 | 20.5 | 20.6 | 20.4 |

The above does not show quite as high an average for 1901 as for 1900, but the figures for the past year were better than

the average for recent years. The Boston market is the only one in the State where statistics are kept, and as Boston is the largest city in the State, and as it is the commercial centre of New England, figures from that market have an exceptional interest.

The Chamber of Commerce figures regarding the butter business in Boston for 1901 and the immediately preceding years are as follows : —

| | 1901. Pounds. | 1900. Pounds. | 1899. Pounds. | 1898. Pounds. | 1897. Pounds. |
|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| On hand January 1, . . . | 3,285,960 | 2,073,800 | 2,829,160 | 2,473,600 | 2,898,000 |
| Receipts for the year, . . . | 57,499,836 | 51,502,840 | 49,757,606 | 50,609,552 | 51,107,033 |
| Total supply, . . . | 60,785,796 | 53,576,640 | 52,586,766 | 53,083,152 | 54,005,033 |
| Exports, deduct, . . . | 5,708,603 | 1,002,374 | 3,051,710 | 1,574,682 | 3,286,333 |
| Net supply, . . . | 55,077,193 | 52,574,266 | 49,535,056 | 51,508,470 | 50,718,700 |
| Stock on hand December 31, deduct, . . . | 4,512,000 | 3,285,960 | 2,073,800 | 2,829,160 | 2,620,680 |
| Consumption, . . . | 50,565,193 | 49,288,306 | 47,461,256 | 48,679,310 | 48,098,020 |

The above table shows a steadily increasing consumption, barring the year 1899. This was the year when prices improved after the depression of three preceding years, and it is possible that the consumers had not adapted themselves to the changing rates. In connection with these figures one fact must be remembered: with the development of other centres in New England, and their securing from the railroads Boston freight rates, Boston loses its relative supremacy as a New England distributing centre: therefore, these annual figures mean more and more the local consumption. With this fact in mind, the steadily increasing consumption is very gratifying.

BUTTER, — IMITATION.

On a previous page we report 88 court cases for violation of the anti-color law and 125 for violation of the hotel-restaurant law. In the enforcement of these laws there also arose 6 cases of obstruction of an inspector of the Bureau, and 1 of assault and battery on an inspector. This makes 222 cases in connection with the oleomargarine — imitation-

butter — laws. Of this number, we lost 17 and not prossecuted 15, 2 were defaulted and there were 186 convictions. Besides these, 3 cases have been taken from the files of different courts and fines imposed, in instances where the defendant had broken his parole and been convicted of subsequent offences. Evidence of violation of the anti-color law is obtained, when possible, by making purchases in stores or of peddlers. Often this cannot be done, because our inspectors are known to the dealer, who will refuse to make a sale; or it may be that he is so suspicious that he will not sell to any stranger. If a purchase cannot be made, the inspector searches the suspected premises, and if any of the imitation article is found, we have a *prima facie* case of intent to sell, which is also prohibited by the statutes. In view of the fact that we cannot depend on the first kind of evidence, but must frequently fall back on the second, our statistics do not prove conclusively how this imitation product is ordinarily sold in the usual channels of trade; that is, we cannot show what the average consumer orders and supposes he is getting. But out of the above 88 violations of the law we had positive evidence in 56 cases that sales of the imitation had been made as and for genuine butter. In other words, we can prove that, out of 88 cases where possession with intent to sell was alleged, we had evidence in 64 per cent. of the cases that a fraud had been actually committed. These figures are certainly no exaggeration. If they err at all, it is on the side of conservatism. It is evident that, if they are faulty, it is in understating the facts. But on the basis of the above figures, which are absolutely accurate, 64 per cent. of the imitation butter manufactured is sold dishonestly. When to this fact is added the further fact that the sales were made at prices varying from 20 to 26 cents per pound, we find a vindication of these laws. Though criticised by some and misunderstood by others, they are for the protection of consumer, producer and honest middleman. Every class in the community is interested in honest foods, and these laws are for the benefit of all. No honest product is discriminated against.

During the year we have found the law violated in an unusual number of hotels and restaurants. In many instances the proprietors or managers were innocent of any attempt to deceive; they were themselves deceived by the person of whom they purchased their supplies; they ordered butter, paid a butter price for what they bought, and supposed they were serving butter. In 12 instances the defendants testified to such facts; but in many others the same information came to us informally, but the defendants were found guilty in court, and the fines paid, under circumstances that made us feel certain that the dealer had stood back of his customer, and paid the fine and expenses. As the fine for selling imitation butter is \$100, while the fine for serving it in a restaurant is only \$10, it is self-evident that the dealer could well afford to hush up in this way any evidence of his own moral obliquity. In one case the attorney of a dealer boldly stood up in court and defended the restaurant manager without having been employed by the latter, in order to use legal skill in suppressing the evidence against the dealer aforesaid.

For the first time in the history of anti-color legislation in this State a violator of the law has been sentenced to imprisonment, and is serving his sentence. The defendant was a persistent seller of colored oleomargarine, which he disposed of as and for butter. He paid a fine in Springfield; he was detected selling the article in Worcester, but ran away; he was found backing another dealer in Holyoke and Chicopee; and finally he was caught peddling in Brockton. He represented himself as agent of the St. Albans creamery, and said its superior product could be obtained only of him. His price was 24 cents per pound. He was a good salesman, and by going from house to house and telling this story he could sell many five-pound boxes in a day, with the minimum risk of detection. But we secured the facts, and put him into the Brockton police court on three complaints. It was his expectation that the usual fine of \$100 would be imposed, which fine he was prepared to pay. Doubtless after charging it off to expense he could show a balance on the right side of the account. He was,

however, thunderstruck at the sentence, and ejaculated in open court, "Such a sentence was never imposed before in this State, your Honor." "Well, it has been done now," replied the judge. It seems to us that it would be well, in the cases of a few other inveterate offenders, if a similar course might be followed by some other judges. Indeed, we are not sure but the law would be more deterrent if the statute required imprisonment for the third or fourth offence. If such a change were made, it might be policy to reduce the penalty for the first offence, so that the law might not seem oppressive, and might act as a warning to the careless or ignorant the first time a person is caught violating its provisions.

In order that the law may seem more forceful in the case of old offenders, we have adopted the policy of multiplying cases against them when we can do so. Otherwise we have feared that the operation of the law might be regarded more as a license than a punishment. If it is impossible for us to reach leading cities and towns in the Commonwealth oftener than once a year, an occasional fine of \$100 might come to be regarded as a part of the regular programme, to be a fixed charge on the business. For this reason we brought 6 cases against one New Bedford dealer, and secured convictions in all, the fines amounting to \$600; a Holyoke dealer has paid 3 fines of \$100 each; 8 convictions were secured against one store in North Adams, with fines aggregating \$900; one of the old offenders of Lowell has been found guilty in 4 cases, the fines amounting to \$400; 5 cases were accumulated against one Worcester store, with fines of \$500; 4 against another; and 3 against still another. Such procedure is not possible in all cases, but we believe it is advisable when it can be done.

One case is still pending in the supreme court. This arises out of the custom of district court clerks receiving complaints and issuing warrants in the name of the court, when no judge is present. Clerks are by statute allowed to receive complaints and issue warrants, but this question grows out of their acting under such circumstances in the name of the court. It is claimed that if by virtue of his

office a clerk receives a complaint, he should issue his own warrant and not the warrant of the court; in the latter case it is claimed that the warrant is issued before the complaint is received by the authority issuing the warrant. A large number of appealed cases are tied up, awaiting this decision.

In the perjury case alluded to in our report of last year the defendant was found guilty and sentenced to a term of imprisonment, which he is now serving.

BUTTER, — RENOVATED.

The law requiring renovated butter to be branded or labelled with its distinctive name is largely a dead letter. This is through no difficulty in enforcing the law, for chemists can easily distinguish renovated butter from normal butter and from imitation butter. The difficulty is wholly with the amount of money which the Legislature allows us to expend. This amount is not enough even to permit us to do as thoroughly as we would like the work entrusted to us before the renovated butter law was enacted. The milk inspector of Lowell has had one case which has been pushed to a satisfactory conclusion in district and superior court; so far as we know, this is the only case that has been tried.

As to the desirability of such a law, opinions differ. The wholesalers generally view it with disfavor, and will ask the Legislature to repeal it. This renovated butter question is rapidly increasing in importance, for the commodity is becoming a staple article of merchandise, and is coming into general use. Almost every store has it, and it has become an important article in the trade. For a second-quality butter it has much to commend it, and it is much better than could be secured as such before the process of butter renovating became common. If it were sold under its true colors, — and that is all the law requires, — it would be a valuable article of commerce. Renovation is always commendable, whether in butter or human beings. Improvement is progress. To take low-grade butter, which would be almost unmerchantable, and renovate it so that it will stand almost in the front rank is a praiseworthy act. But experience and

observation covering the retail markets of the whole State, including those selling from both stores and wagons, convince us that in many instances the consumer does not know what he is buying, and the article is sold dishonestly. When any inferior article is thus sold dishonestly as something better than it is, it becomes a damage to legitimate business.

We believe that renovated butter, as it is ordinarily sold, is a menace to the business in natural butter. Notice that we use the word "natural" butter, in distinction from "renovated" butter. Renovated butter is unquestionably the real product of the cow's udder, without adulteration, generally speaking (a little glucose is sometimes added, to give it body or grain); but the process of renovation so changes the substance that, though it still remains real butter, it is no longer natural butter. It boils like oleomargarine, rather than natural butter; it appears under the polariscope more like oleomargarine than natural butter; in some kinds of cooking it will not take the place of natural butter. Consequently, we claim that renovated butter is not natural butter. Though the wholesale trade, as stated above, almost unanimously oppose the use of a distinctive brand or label which shall apprise the consumer of its real character, there are those in the butter business who do not hesitate to say that as usually retailed it is as great a menace as unregulated oleomargarine would be. One dealer says that the trade is committing slow suicide in the course things are taking.

Here are some facts which we can substantiate. When the best creamery butter was quoted in assorted size tubs, in a strictly wholesale way, at 22 to 22½ cents per pound, a large Boston retailer advertised in a showy manner in the Sunday papers that he "owned creameries in the finest dairy sections of the country," and could therefore sell direct to the consumer an article of "superb quality," at a very low price. This dealer, having made this boast, thereupon offered "Locust Valley Elgin Creamery Butter" at 22 cents per pound in five-pound boxes, and at 21 cents per pound in tubs. A Bureau inspector purchased one of the five-pound boxes at 22 cents per pound, — less than the extreme wholesale price of butter in tubs in round lots, — and the stuff

proved on analysis to be renovated butter. Such things seem to us to be more of an injury to business than the single transaction between the seller and the individual buyer, for the quoting such a price in such a misleading way tends to unsettle values, to impair confidence and to injure producer and middleman. At the same time alluded to above another large retailer was advertising fine Vermont dairy butter at 22 cents per pound; our inspector bought some, and it proved to be renovated butter which probably never saw Vermont. In a suburban town a dealer sold his "best creamery butter" at 28 cents per pound to one of our inspectors, and this, too, proved to be renovated butter. A creamery manager in the western part of the State writes us: "Mr. — of this town advertises continuously 'Elgin creamery butter, 25 cents per pound.' This business ought to be stopped, for this figure is less than our wholesale price." We could multiply such statements almost indefinitely, but they would be merely cumulative.

We have endeavored to present fairly the position of both sides of the case. We have no personal interest in the matter, and regret that our convictions run counter to those of the trade and many personal friends who have stood loyally by the cause of honest butter in opposition to oleomargarine.

MILK.

The cost of production has greatly increased during the past year, particularly the latter portion, on account of the higher price of the grain fed to milk cows. This has resulted in movements in many places for an advanced price for milk. These agitations have generally been successful, and 7 cents seems to be the prevailing retail price, at least outside of Boston. There considerable milk is retailed at 8 cents, and in case of superior milk an extra figure is secured. In some instances farmers have become discouraged at the low or unprofitable price, and curtailed their production. The demand for milk has been very good, or at least until near the close of the year. It is yet too early to tell the lasting effect of higher prices upon the consumptive demand for milk. But milk at retail has not yet reached such a figure

as to take it out of the list of the cheapest foods one can purchase. When milk is 7 cents per quart, the dry, solid portion of average milk — every portion digestible, with no refuse — costs only 27 cents per pound. We think there is a steady gain in the quality of the milk retailed in the State. The literature circulated by the agricultural press and experiment stations is surely leading to improved and cleaner methods, better ways of caring for the product, and more attention to details which have an important bearing upon the quality of milk.

In the enforcement of the milk laws we have taken 189 samples of milk or cream, and had 30 cases in court on the following charges : —

| | |
|---------------------------|-------|
| Adulteration, | 10 |
| Under standard, | 20 |
| | <hr/> |
| Total, | 30 |

Conviction followed in each instance. The adulterant used in 8 of the cases was some coloring matter to give an appearance of richness, when a portion of the cream had been removed. In 2 instances the proportion of fat to solids not fat was such as to prove that water had unquestionably been used as the adulterant, and the charge was made accordingly. Under the law of 1900 judges have more latitude than formerly in the matter of fines when milk is not of standard quality, and the fines imposed in the above cases ranged from \$5 to \$100. Most of them were the lower figure, and the larger sum was an aggravated second offence. Under the old law, \$50 was the minimum in all such cases. The analysis of the milk in the cases prosecuted showed total solids as follows : —

| | | | |
|-------|-------|-------|-------|
| 10.90 | 11.40 | 11.50 | 11.24 |
| 11.54 | 11.90 | 11.40 | 11.20 |
| 12.50 | 10.66 | 11.10 | 8.70 |
| 12.10 | 11.64 | 9.70 | 10.50 |
| 10.06 | 11.20 | 11.28 | 10.60 |

With the increasing importance of the cream trade and the increasing amount of pasteurizing of cream, dairymen found a serious obstacle in their business. Pasteurizing

cream makes it more fluid, and hence less acceptable to people who have been educated to associate richness with thickness. It was impossible to convince them that a thin cream might have as much fat as a thick cream. As the increasing use of cream made it necessary to ship the article considerable distances, compelling pasteurization, the trouble threatened to become serious, until Professor Babcock came to the relief of the situation with the statement that viscogen (sugar of lime) added to cream in very small amounts would restore its viscosity without adding any deleterious feature. Consequently this practice has been adopted to a considerable extent, and has the sanction of the best dairy authorities in the country, though it is a violation of Massachusetts law, which forbids the addition of "any foreign substance." During the past year information has come to us of the use of this substance to promote dishonesty and to injure the trade in cream. A gentleman who was selling a 50 per cent. cream came in competition with an article which was claimed to be "just as good," but which was sold at a cut price. Samples were taken, and the competing cream was found to have only 30 per cent. of fat; but it was thickened with viscogen, so as to have the viscosity of the 50 per cent. article. An unfortunate feature of the business is the difficulty of determining the addition of this adulterant with sufficient certainty to maintain a case in court, lime being a natural ingredient of cream, and in variable amounts.

BOSTON MILK.

The situation in Boston has been of exceptional interest during the past year, and milk history has been made rapidly. As stated in a previous report, the wholesale price and the price to producers in October, 1900, advanced 4 cents per can over the winter price which had prevailed for four years, for the winter period of six months, at the city end of the line. The advance to consumers, with an unwise agitation, proved too much for the market, and on the 1st of January, 1901, the producers' price dropped 2 cents. This was the first time in the history of the trade, or at

least for many years, when there was a change in one of the six months' periods. The unusual nature of the situation at the beginning of the year was increased, when negotiations for the summer price began, by a demand on the part of the producers for an abolition of the time-honored practice as to the manner of computing the return to be made to the farmers for surplus milk. The wholesalers, contractors, had been in the habit of contracting for an indefinite quantity of milk at a fixed price, subject to the proviso that the farmers should be paid butter value for the surplus. This provision on the contractors' cards we find for the first time in September, 1886. Consequently, if Farmer A was to have 26 cents per can, and he shipped to market 1,000 cans of milk in a month when the butter value of milk was 15 cents per can, and the surplus was 25 per cent. of the receipts, his account would be accurately figured thus:—

| | | |
|---|-----------|----------|
| 750 cans of milk, at 26 cents per can, | | \$195.00 |
| 250 cans of milk, at 15 cents per can (butter | | |
| value), | | 37.50 |
| | | <hr/> |
| Total, | | \$232.50 |

But the contractors reached this conclusion in a different way for their convenience in keeping their accounts. They first computed the average price per can for the month, which in the above case it will be seen was 23.25 cents per can; this figure being 2.75 cents less than the regular price, the farmer's account would be made up by the contractors as follows:—

| | | |
|--|-----------|----------|
| 1,000 cans of milk, at 26 cents per can, | | \$260.00 |
| Discount for surplus, | | 27.50 |
| | | <hr/> |
| Balance due, | | \$232.50 |

The farmer got the same amount of money by each way of making the computation, but the contractors' method was blind, putting a premium on misunderstanding, and being a direct bid for confusion and trouble. An apparently arbitrary discount, misunderstood and obscure, naturally was a source of great irritation, and for years it was the frequent theme for discussion at milk meetings. This surplus was

most burdensome in 1897, when it reached the immense proportions of 3,059,619 cans, nearly 35 per cent. of the sales. Since then it has been decreasing, and had fallen off to 1,632,146 cans in 1900. But in March of 1901 a formal demand was made by the Milk Producers Union for an abolition of the surplus provision, and for a "straight price," that is, one price for all milk sold to the contractors, so that the producer would know, when the milk left his dairy, exactly what he would receive for it. The contractors resisted this demand, and a milk "strike" followed. The farmers held together with great unanimity and praiseworthy harmony, keeping back a large proportion of the city's milk supply. But the contractors reached out farther, into adjoining States, and secured so much milk that the consumer would not know, except from the newspapers, that there was any disturbance in the market. At length the power of negotiation prevailed, and a compromise was arranged, by which those who wanted a "straight price" secured it by agreeing on a deduction for surplus, as explained above, of 2 cents per can.

At the time for making the trade for the winter price of 1901-2 the average price of last winter was fixed upon, with the agreement that the discount for the surplus for the next six months should be determined in advance to be $1\frac{1}{2}$ cents per can. There were further agreements looking to a more even supply and guarding the producers if the actual surplus should fall below the prearranged discount. On account of the shortage of milk, which promised to be serious on account of the increasing cost of production, the contractors voluntarily raised the price 4 cents per can in December, and the increase is to continue through January. The following table shows the wholesale price of milk in Boston for twenty years. The price that the farmer received has been a fixed discount from this, varying according to the distance from Boston. We have included in the table the price which the producer in the middle belt has received during this time, the price being what he has received for all milk consumed as such in Boston, and not the average income of his dairy when both sale milk and butter

value of surplus are considered and averaged. The figures are for 8½ quart cans.

| YEAR. | Summer Boston Price, — April to October (Cents). | Net to Producer in Fifth Zone (Cents). | YEAR. | Winter Boston Price, — October to April (Cents). | Net to Producer in Fifth Zone (Cents). |
|---------|--|--|------------|--|--|
| 1882, . | 35 | — | 1882-3, . | 43 | — |
| 1883, . | 35 | — | 1883-4, . | 40 | — |
| 1884, . | 34 | — | 1884-5, . | 42 | — |
| 1885, . | 30-32 | — | 1885-6, . | 36-37 | — |
| 1886, . | 30 | — | 1886-7, . | 36 | — |
| 1887, . | 30 | — | 1887-8, . | 36 | 24 |
| 1888, . | 32 | 21 | 1888-9, . | 38 | 27 |
| 1889, . | 32 | 21 | 1889-90, . | 38 | 25 |
| 1890, . | 32 | 21 | 1890-1, . | 36 | 25 |
| 1891, . | 33 | 22 | 1891-2, . | 37 | 26 |
| 1892, . | 33 | 22 | 1892-3, . | 37 | 26 |
| 1893, . | 33 | 22 | 1893-4, . | 37 | 26 |
| 1894, . | 33 | 22 | 1894-5, . | 37 | 26 |
| 1895, . | 33 | 22 | 1895-6, . | 37 | 26 |
| 1896, . | 33 | 22 | 1896-7, . | 35 | 24 |
| 1897, . | 31* | 22 | 1897-8, . | 33* | 24 |
| 1898, . | 31 | 22 | 1898-9, . | 33 | 24 |
| 1899, . | 31 | 22 | 1899-0, . | 33 | 24 |
| 1900, . | 33 | 24 | 1900-1, . | { 37 to Jan. 35 | 28 to Jan. 26 |
| 1901, . | 33† | 24 | 1901-2, . | { 36‡ 40 in Dec. | 25.5‡ 29.5 in Dec. |

* This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

† Those producers who preferred had 31 cents, with no discount on account of the surplus.

‡ In the trade with the contractors a surplus discount of 1.5 cents was agreed upon; 25.5 is the net to the farmer after the surplus discount is deducted, and is equivalent to 27 cents, from the standpoint of the preceding figures.

The following table gives the receipts, sales and surplus of railroad milk brought into greater Boston, in 8½ quart cans, as reported by the contractors' association: —

| 1901. | Receipts. | Sales. | Surplus. |
|----------------------|-----------|-----------|-----------|
| January, | 802,346 | 701,026 | 101,320 |
| February, | 728,076 | 637,968 | 90,108 |
| March, | 867,095 | 733,817 | 133,278 |
| April, | 543,164 | 439,471 | 103,693 |
| May, | 972,067 | 743,962 | 228,105 |
| June, | 1,019,722 | 746,889 | 272,833 |
| July, | 941,652 | 796,560 | 145,092 |
| August, | 856,878 | 728,592 | 128,286 |
| September, | 813,127 | 734,253 | 78,874 |
| October, | 846,368 | 768,461 | 77,907 |
| November, | 739,101 | 712,974 | 26,127 |
| December, | 756,707 | 712,164 | 44,543 |
| Totals, | 9,886,303 | 8,456,137 | 1,430,166 |

| | Receipts. | Sales. | Surplus. |
|-----------------|------------|-----------|-----------|
| 1900, | 10,607,684 | 8,975,538 | 1,632,146 |
| 1899, | 11,234,764 | 8,911,971 | 2,322,793 |
| 1898, | 11,317,761 | 8,564,682 | 2,753,079 |
| 1897, | 11,798,191 | 8,738,572 | 3,059,619 |
| 1896, | 10,772,108 | 8,087,378 | 2,684,730 |
| 1895, | 9,856,500 | 8,040,732 | 1,815,768 |
| 1894, | 9,705,447 | 7,657,421 | 2,048,026 |
| 1893, | 9,263,487 | 7,619,722 | 1,643,765 |
| 1892, | 9,212,667 | 7,315,135 | 1,897,532 |

The record of receipts has shown a steady decline since 1897, which is not a wholly undesirable condition, as consumption has held its own, or increased. Hence the smaller

amount of receipts means a great reduction in the surplus. The receipts for 1901 were the smallest in six years, the surplus was the smallest for ten years. The receipts have run uniformly less during each month of the year, but the sales have been very uneven relatively from month to month; one month they would be less than the average, or the smallest for several years, while the next month they would be the largest on record, with perhaps a single exception. The purchase of milk by the large wholesalers has not kept pace with the increase of population.

The butter value of milk in cents per can for 1900 and 1901 was: —

| | 1901. | 1900. | | 1901. | 1900. |
|-----------------|-------|-------|------------------|-------|-------|
| January, . . . | 16.20 | 19.34 | July, . . . | 13.87 | 13.59 |
| February, . . . | 16.60 | 18.00 | August, . . . | 14.47 | 14.70 |
| March, . . . | 16.85 | 17.93 | September, . . . | 14.53 | 15.19 |
| April, . . . | 14.62 | 13.22 | October, . . . | 14.92 | 14.91 |
| May, . . . | 13.05 | 13.95 | November, . . . | 15.94 | 16.43 |
| June, . . . | 13.78 | 13.50 | December, . . . | 16.88 | 17.52 |

MILK IN OTHER CITIES.

A number of milk inspectors have kindly furnished us some information about the milk business in their several cities, from which we compile the following: —

Somerville: population, 61,643; consumption of milk, 21,400 quarts per day; trade fully as good as last year.

Lowell: population, 94,966; consumption of milk, 30,268 quarts daily; about one-third is sold to boarding houses and stores at wholesale; nearly all is sold by middlemen; there is a tendency to take better care of milk brought into the city.

New Bedford: population, 62,442; consumption of milk, 27,000 quarts per day; about one-third is retailed by producers; the quality is generally very good.

Cambridge: population, 91,886; consumption of milk, 36,344 quarts per day; about one-half is sold from stores

and one-half from wagons; 224 cans daily are raised in Cambridge, and 504 cans are sold by producers; wagon milk comes in from Waltham, Lexington, Arlington, Belmont, Concord, Lincoln, Wayland, Burlington, Dover, South Sudbury, Bedford, Holliston, Billerica, Needham, Sharon and Southborough; there is a tendency on the part of the big contractors to absorb the retail routes; condensed milk has lately replaced fresh milk to some extent.

Worcester: population, 118,421; consumption of milk, 34,000 quarts daily; 61 per cent. of the dealers are middlemen.

Lawrence: population, 62,559; daily consumption of milk, 24,000 quarts; about 40 per cent. is sold by producers; the quality is improving.

Lynn: population, 68,513; daily consumption of milk, 22,950 quarts; about two-fifths is retailed by the producers; there is a tendency to concentration among the dealers.

Holyoke: population, 45,712; consumption of milk daily, 17,500 quarts; a large proportion is sold by non-producers; the quality is improving.

Some years ago, in some figures for the national department of agriculture, the writer of this report endeavored to ascertain whether there was any law of average underlying the consumption of milk in the larger cities of New England, with the following result (the figures represent hundredths of a pint per capita of population):—

| | | |
|-------------|-----------|------|
| Boston, | | .96 |
| Hartford, | | .94 |
| Nashua, | | .84 |
| Burlington, | | 1.00 |
| Haverhill, | | .90 |

The following is deduced from the above figures from Massachusetts cities:—

| | | |
|--------------|-----------|-----|
| Somerville, | | .69 |
| Lowell, | | .63 |
| New Bedford, | | .86 |
| Cambridge, | | .79 |
| Worcester, | | .57 |
| Lawrence, | | .76 |
| Lynn, | | .67 |
| Holyoke, | | .77 |

EDUCATIONAL.

The educational work of this department has not been neglected during the past year. Six meetings have been addressed by members of the Bureau, and the general agent has been called upon fourteen times for addresses. There have been three calls on him for Babcock test demonstrations before audiences; but the test is now so well known that this class of calls is less than formerly. There have been three calls for the use of this test on other occasions. One of these was the awarding the sweepstakes dairy prize of the Worcester South Agricultural Society. The general agent has acted as judge of this class for the society for a number of years.

CODIFICATION OF DAIRY LAWS.

The dairy laws of this State have been a growth. Almost every year since 1856 there have been amendments and new legislation, and in some instances the practice under these laws has been modified by court decisions. Hence the dairy laws needed codification and revision more perhaps than the laws in any other department. Revision, however, was beyond the scope of the work undertaken by the recent commission and the Legislature of last year but the codification has resulted in great improvement.

Owing to the somewhat complicated nature of the case, the work left the codification commission with a few serious errors; for example, the selling of milk not of standard quality was not prohibited, two standards for skimmed milk were created, and a law relative to duplicate samples (declared by the supreme court as repealed by implication) was continued. At the request of the sub-committee of the Legislature having the matter in charge, the general agent of the Bureau met with them several times and gave much attention to this work. As a result of their efforts, all serious defects were remedied, and the codification seemed perfect. But in the final copying and renumbering of sections a few relatively unimportant errors crept in. The attention of the legislative sub-committee was called to these, but they

replied: "We deemed it wise not to offer any of the amendments. The Legislature seemed bound not to make any changes whatever except where the change was necessary on account of some provision of law which would be made inoperative unless the change was made."

These errors are three. Section 42, relative to complaints to be instituted by inspectors of milk, omits allusion to the renovated butter law. Section 61, which imposes a penalty for milk inspectors conniving at or assisting in a violation of the provisions of several sections, includes in the list section 70, which relates to the inspection of meat and provisions. Section 64 orders milk inspectors to make complaints on information as to the violation of several laws, and includes those requiring the Hatch experiment station to inspect Babcock testers and the glassware connected therewith.

The codification has improved the phraseology of the laws in several respects, particularly in a general definition of butter and oleomargarine, which saves several verbose repetitions. The commission and the committee saw several places where the laws could be still further improved, but most of these changes seem to border on new legislation, and were therefore debarred. One change seems to us to be required. Some of the fines go to the Commonwealth, and some go to the cities or towns where the offence is committed. There is no reason for such lack of uniformity, which introduces an element of confusion, and sometimes occasions trouble. It would be much better, both in theory and practice, if all the fines arising under these laws were disposed of uniformly. We recommend that all take the same course, and go to the cities or towns where the offence is committed, as is the case with the greater portion of the fines for other offences.

The codification makes a change in the spirit of and practice under one law. Chapter 169, Acts of 1899, directed an officer who obtained a sample of milk for analysis to send, within ten days of the "procurement thereof," the result of the analysis to the person from whom the sample was taken. In the opinion of the Attorney-General and the codification

commission, the words "procurement thereof" referred to the nearest noun, to wit, analysis; hence the Revised Law (section 63) requires the person who obtains the sample to send the prescribed notice "within ten days after obtaining the result of the analysis" from the chemist.

NATIONAL ASSOCIATION. — MASSACHUSETTS COURTS.

In October the general agent of the Bureau attended the annual Convention of Dairy and Food Commissioners at Buffalo. He read a paper on the practical enforcement of food laws. The paper showed that the enforcement of these laws is sometimes criticised from the theoretical stand-point by persons without knowledge of ordinary procedure under criminal laws, and without experience. The theoretical critic seems to regard these laws like an automatic machine, which moves with the relentless precision of the buzz saw or pile driver. But the practical enforcement of food laws varies much from the inexorable blow of the inanimate machine, because of (1) the limitations and demands of the laws of evidence, (2) the personal element in judges and jurors, (3) the discretion allowed prosecuting officers, whether agents of food departments or district attorneys. This difference between the practical and theoretical enforcement of criminal laws in general and food laws in particular is not a weakness, when broadly considered. The defendant has the benefit of every precaution to prevent the innocent being unjustly condemned; and when conviction is secured, justice can be tempered with mercy. We believe the laws have more respect from the community at large, and even from the criminal classes, on account of the human element that comes in play, from the fact that decisions are reached by men with the traits of a common human nature.

These meetings with officers engaged in similar work in other States are always beneficial, and at times exceedingly interesting. One effect is to impress us with the superiority of the Massachusetts system of courts, and the way in which the system works. We believe one may justly take pride in the same. The form of our procedure, the high character of our judges even in the lower courts, and the tone of pub-

lic sentiment here, are more highly appreciated after one has had an opportunity to learn the troubles of those engaged in similar work elsewhere. Imagine the only way to begin criminal proceedings to be through the grand juror or the grand jury ; imagine grand jurors appointed by selectmen or aldermen, and reflecting the views of the appointing power ; imagine cases smothered by a district attorney, because he does not favor some law ; imagine the frequent failure of grand juries to indict, in spite of evidence, if they do not like any particular law ; imagine one grand jury at a single session refusing to find bills in 300 cases of violation of a law unpopular with the jurors ; imagine petit jurors being judges of law, as well as of evidence, and refusing to convict because in their judgment some law is unconstitutional ; imagine being obliged to begin civil suits to collect fines after the criminal court has imposed them, — all these things happen in other States, not all in any one State. On one occasion the writer of this told a group of commissioners in the course of conversation that in Massachusetts it is no unusual thing for a judge to charge a jury that their opinions as to the merit of the law should not be a factor in the conclusion they might reach ; that their duty was merely to determine whether the evidence in the case bore out the charge in the complaint. More than one commissioner expressed surprise at the statement, and said that judges in his State would not do so.

MISCELLANEOUS.

In many instances our inspector is the only witness to the violation of law, and sometimes his evidence in court is disputed by the defendant. There is then the word of one man against that of another. In such circumstances the witnesses are usually sharply cross-examined, with a view of getting at the facts in the case, to determine as far as may be the truth of their stories. To illustrate : During the year an inspector found an imitation-butter pedler in Lawrence with some of the contraband article in his wagon. The inspector started to take a portion for analysis, but he was forcibly prevented from securing the sample. The pedler was brought before the police court, charged with interfering

with an officer of the Dairy Bureau. At the trial of the case the inspector told his story, and the defendant denied substantially every material portion of the inspector's evidence. The inspector was cross-examined by the defendant's lawyer, and the defendant was examined by the general agent of the Bureau, the judge himself asking several questions. As a result of this careful investigation, the fellow was found guilty and fined. He appealed, and in the superior court there was the same conflict of evidence and a similar cross-examination of witnesses by the defendant's lawyer and the district attorney. As a result of this sifting of the varying stories, the jury believed that the man was guilty, and so found. Now, Judge Berry of the Lynn police court interprets the law of evidence as requiring him to acquit a defendant against whom there is only one witness, if the defendant denies or even questions the story of that witness. This judge, therefore, says that, if we are to be allowed to swear out complaints in his court, we must duplicate our evidence, — have our inspectors travel in pairs, so that the story of one may be corroborated by the story of the other. If this is good law, the practice will eventually be adopted by the other courts and will result in halving the amount of work we can do, or will require double the present appropriation, if the present degree of efficiency is to be maintained.

As the work of the Bureau continues, the increasing experience of the official in charge causes the calls upon him to grow broader in their scope. He has been for a number of years a lecturer on dairy topics before one of the schools of domestic science in the city. In January he was sent to Washington by the butter men of the Boston Chamber of Commerce, in the interests of the Grout bill, so called. This bill is of much interest to Massachusetts, as it will make its policy as regards imitation-butter legislation in harmony with the Constitution by act of Congress rather than by the divided opinion of the supreme court. The Bureau's general agent, as the representative of the dairy interests of the State, has been placed on the board of officers of the National Farmer's Congress and also of the Na-

tional Association of Dairy and Food Commissioners. In August he was appointed a special expert of the national department of agriculture, to inspect dairy exports from the port of Boston in connection with recent national legislation. The duties of the position will not be very large, as Boston is not much of an export point for dairy products, and as most of what exports there are come from the west on through bills of lading, and are transferred directly from the cars to the boats. We expect that in a general way being in closer touch with the dairy business will be in the line of increased efficiency in work for the State.

The following is a classified statement of the expenses of the year : —

| | |
|---|------------|
| Members of the Bureau, travelling and per diem for attending meetings, | \$297 56 |
| Educational work, | 103 86 |
| Inspectors' salaries, | 1,775 35 |
| Inspectors' expenses, | 2,414 39 |
| Chemists, | 1,650 36 |
| Geo. M. Whitaker, travelling expenses, postage, express, telegrams, etc., | 652 07 |
| Printing and supplies, | 106 41 |
| | <hr/> |
| | \$7,000 00 |

GEORGE M. WHITAKER,

General Agent.

Accepted and adopted as the report of the Dairy Bureau.

J. LEWIS ELLSWORTH.
CARLTON D. RICHARDSON.
FRED W. SARGENT.

ABSTRACT OF ANNUAL REPORT

OF THE

BOARD OF CATTLE COMMISSIONERS

OF THE

COMMONWEALTH OF MASSACHUSETTS.

JANUARY 10, 1902.

REPORT.

To the Honorable Senate and House of Representatives.

The Board of Cattle Commissioners herewith presents its annual report, as required by section 3, chapter 90 of the Revised Laws.

The Massachusetts Cattle Commission is among the more venerable of the many commissions of the Commonwealth; its establishment antedates the civil war and the various commissions and organizations that sprung into existence since that time.

The first Cattle Commission was appointed for the purpose of eradicating contagious pleuro-pneumonia among cattle, April 6, 1860, its members being Paoli Lathrop, Amasa Walker and Richard S. Fay. Two weeks later Richard S. Fay resigned and Dr. George B. Loring was appointed in his place. An extra session of the Legislature was called, May 30, 1860, for further legislation, which resulted in increasing the membership of the Board to five members for the time being. Contagious pleuro-pneumonia was introduced into Massachusetts by W. W. Chenery of Belmont, who imported two cows from Holland in June, 1859, which were suffering from this disease. As a result of sales from this herd, the disease was carried to Worcester County and also later appeared along the south shore. One of the final reports of the Cattle Commission with reference to stamping out contagious pleuro-pneumonia is dated Dec. 28, 1866, is signed by E. F. Thayer, Charles P. Preston and F. D. Lincoln, and shows the expense to the Commonwealth to have been \$67,511.08. The final report, Dec. 30, 1867, says no new cases have occurred during the year.

Contagious pleuro-pneumonia was first brought into the United States in 1843, by a cow that was owned by a sea captain, and landed from the ship at Brooklyn, N. Y.,

whence it spread to New Jersey, Pennsylvania, Maryland, the District of Columbia and parts of Virginia. At length in 1884 contagious pleuro-pneumonia crossed the Alleghenies to Ohio, was taken thence to Illinois, and from there to one or two places in Missouri and to Cynthiana, Ky. It was stamped out in these places, but appeared in 1886 in the great distillery stables in Chicago, where it wrought great havoc. Finally, in about 1884 or 1885, Congress appropriated \$500,000 for its eradication, and passed a bill allowing federal to co-operate with State authorities for its extinction. It was finally eradicated from the United States, it is hoped never again to obtain a foothold here, but not until the United States government assisted other States to do what Massachusetts was able and willing to do for herself in 1860 to 1866, when the country was also engaged in the great civil war, and the resources of the State were severely taxed to assist in carrying it on.

In February, 1862, an act was passed providing for the appointment of a new Cattle Commission: and Dr. E. F. Thayer of Newton, H. L. Sabin of Williamstown and James Ritchie of Roxbury were appointed on the Board. Even in 1862 we find in the annual report the statement that, if New York, New Jersey and Pennsylvania would follow the example of Massachusetts, it would be an effective mode of securing the whole community against this disease, — contagious pleuro-pneumonia.

In 1868 the appearance of Texas fever in Brighton market, whence it was carried to other points, called forth the efforts of the Cattle Commission again. This year we find still a member, Dr. E. F. Thayer of Newton, who continued on the Board until 1885, and Hon. Levi Stockbridge of Amherst, who served until 1894, and was then reappointed for three years more. Mr. Stockbridge, if he had chosen, might have served continuously for thirty years, but resigned immediately after his last appointment.

In 1869 an outbreak of what appears to have been anthrax, in the western part of the State, occupied the attention of the Board for a portion of the time.

In 1870 sporadic pneumonia, anthrax and foot and mouth

disease seems to have made a good deal of work for the commission.

The report of Jan. 10, 1871, is signed by H. W. Jordan, in addition to Messrs. Thayer and Stockbridge, and he appears to have continued as a member at times until the reorganization in 1885.

In 1871 foot and mouth disease, or epizootic aptha, again demanded attention from the Cattle Commissioners.

The report for 1872 speaks of investigating a supposed outbreak of contagious pleuro-pneumonia, which proved to be sporadic pneumonia; and also mentions the occurrence of spinal meningitis among horses, and the great equine epizootic in the fall of 1872.

In 1873 the services of the commission were not required, and in 1874 it had very little to do beyond investigating two or three outbreaks of Texas fever.

In 1875 the Board was again called upon to investigate outbreaks of Texas fever, and also recommends special legislation to prevent its entrance during the summer months.

In 1876 no Texas fever appeared, as a result of the legislation asked for in the previous year's report; two outbreaks of disease thought to be contagious pleuro-pneumonia were investigated, and found to be due to some other cause.

In 1877 Texas fever again appeared, and was combated manfully by the Cattle Commissioners.

In 1878 glanders and farcy in horses, asses and mules was placed in charge of the Cattle Commission, and has called upon it for a great deal of attention every year since. The report for 1878 advises additional legislation for dealing with this disease.

In 1879 the State adopted the policy of paying four-fifths the value of horses killed for glanders, although the commission in its report for 1878 gives it as its opinion that a horse with glanders or farcy has no value. A total of \$1,668.44 was the expense of the commission for this year, calling for a deficiency appropriation of about \$1,000.

In 1880 the State seems to have continued paying a small amount for glandered horses. In the report for this year the first mention is made of tuberculosis in cattle, and the

commission is uncertain of its being contagious, and therefore decides not to consider it so, and consequently not a disease with which it is called upon to deal officially. The report also mentions an outbreak of verminous bronchitis in calves, and a similar one in swine.

From the report of the commission for 1881 it appears that the State has decided that a glandered horse has no value, and has repealed the law providing for paying four-fifths of a diseased horse's apparent value. This report is also the first one to mention hog cholera.

In 1882 the work of the Board seems to have been chiefly in connection with glanders, but it speaks of the importance of keeping organized, in order to cope with any danger which may be imported from other States.

During 1883, 1884 and 1885 the commission continued in much the same way as already described. In 1885 it was reorganized, with Prof. Levi Stockbridge of Amherst, A. W. Cheever of Dedham and Dr. J. F. Winchester of Lawrence, as members, and continued to be thus organized until 1889.

In the report for 1888 there is an article by Dr. Winchester, calling attention to the importance and prevalence of tuberculosis among cattle, and mentioning the fact that Koch discovered the bacillus of tuberculosis, and believes it to be the same in man and the lower animals.

In 1889 Mr. O. B. Hadwen of Worcester was appointed in Dr. Winchester's place. The Board continued with this change in the membership until 1892. In April of this year the commission was reorganized, with Prof. Levi Stockbridge of Amherst, Dr. Charles P. Lyman of Boston and Dr. Maurice O'Connell of Holyoke as members. Tuberculosis among cattle is added to the list of contagious animal diseases, to be killed without appraisal or payment. Under this law 81 tuberculous cattle were killed.

In 1892 the law was first passed requiring the appointment of an inspector of animals and provisions in every city and town in the State.

In 1894 it was decided to increase the commission to five members, on account of the extra work tuberculosis was sup-

posed to entail. In June of that year Dr. F. H. Osgood of Brookline and Leander F. Herrick of Worcester were appointed to the Board. It was also enacted, in 1894, to pay half the appraised value of tuberculous cows killed by order of the commission. In October, 1894, Charles A. Dennen of Pepperell was appointed to succeed Prof. Levi Stockbridge, who resigned after being reappointed for another three-year term.

In 1895 compensation was increased to full appraised value, with a limit not exceeding \$60 for cattle condemned and killed as tuberculous.

The more recent history of the commission is a matter within easy reach of every one's memory. The opposition of the farmers to having a compulsory tuberculin test of all the cattle in the State; the appointment of Dr. J. M. Parker, in October, 1896, to succeed Dr. C. P. Lyman; the resignation of Dr. Osgood in December, 1896, and the appointment of Dr. Austin Peters to the position; the large appropriations of \$300,000 and \$250,000 for the eradication of contagious diseases of animals in 1896 and 1897; the reaction in 1898, with the reduction of the appropriation to \$20,000, and the attempt to legislate the Board out of existence, — are all occurrences of comparatively recent date.

In 1899 the laws relating to contagious diseases of animals were once more recodified, the commission reduced to three members again, and more conservative methods have since prevailed, with an annual expenditure of a smaller amount of money than a few years ago.

The foregoing history of the Massachusetts Cattle Commission is given to call attention to the length of time it has been in existence and the varied duties it has been called upon to perform; and to emphasize the fact that it is not a tuberculosis commission alone, but was created to protect the live stock interests of the State from the ravages of all contagious animal diseases, and incidentally to protect the public health from the dangers of disorders common to animals and man.

The invested capital in the live stock industry exceeds that of any other in the United States. It is said that the business in the Chicago stock yards during the past year

exceeded the combined other industries of Chicago by \$20,000,000. While not of such vast importance in Massachusetts, yet it is of sufficient importance to be worthy of careful attention and consideration.

An intelligent and civilized community demands a suitably organized system of veterinary sanitary police, and at times it is called upon to exercise powers of the most autocratic nature. While its rules and regulations may seem unreasonable and severe to the individual on some occasions, yet they are for the public good, and call for the subordination of private pecuniary interests to the welfare of the community.

The Cattle Commission estimates that it will need \$50,000 to carry out its duties during the coming year. This will be necessary to fulfil the requirements of the law. The examination of and payment for cows diseased with tuberculosis, the examination and killing of horses with glanders and farcy, investigations and control of other contagious animal diseases, and continuing quarantine regulations preventing the importation of diseased cattle from other States, are likely to require this amount. It is also suggested that an additional appropriation of \$25,000 for testing herds at the request of the owner would be of great value towards diminishing the frequency of bovine tuberculosis, and making greater advances towards its suppression. Many farmers would like to have the commission test their herds, but most of them have to be refused, because the Board has not money enough to do more than its regular work. Fifty thousand dollars is a necessity; the additional \$25,000 is an agricultural matter, but will tend to further decrease bovine tuberculosis.

The reports of the annual inspection of cattle made by the inspectors of animals in 1900 shows an examination of 33,000 herds, comprising 258,268 head of neat stock, of which 181,105 were cows. The number of animals quarantined by the inspectors on suspicion of being tuberculous was 3,249. Of these, 954 were released by the Board, as not showing sufficient evidence of disease to be condemned; 1,425 were killed and paid for; 43 died in quarantine, and were not paid for; and 64 were killed because the owners

were not satisfied that they were not diseased, and the hides and carcasses were given to the owners when the animals were found to be fit for beef. Dec. 1, 1900, 48 cattle were released from quarantine because there was a lack of funds to pay for them, but some of them were requarantined and killed after Jan. 1, 1901. In spite of these precautions, the expenses of the commission exceeded its appropriation by \$3,408.11, and this amount was provided for by two deficiency appropriations passed by the Legislature of 1901. The appropriation in 1900 was \$50,000, and in 1901 an equal amount was again appropriated. It has been the aim of the commission to keep within the limits of its appropriations, and this past year it has succeeded in doing so, and will have a margin of between \$200 and \$300 left to meet any unexpected incidental claims that may be made. To do this, it again refused to take any cattle after Dec. 1, 1901, but only 10 or 12 animals were quarantined after this date by the inspectors, showing a slightly improved condition in the cattle of the State in 1901, as compared with 1900. These few animals will be taken care of, if necessary, after Jan. 1, 1902.

From the work done in 1900 and 1901 it appears that about $\frac{1}{2}$ per cent. of the neat cattle of the State are found to be tuberculous, on a general inspection, the diagnosis being based on a physical examination, and not on the tuberculin test. On a tuberculin test the per cent. of infected cattle would of course be much larger,—at least 10 per cent. of the bovines in the State; but most of them have not sufficient disease to be a danger either to other animals or the health of the community. The appraised value of animals killed by order of the commission has been steadily decreased from year to year for the last few years. In 1900 the average paid per head was \$21.66; in 1901 it was further reduced to \$20.36 per head. The average appraisals of the different agents is also much more uniform now than in the past. The reports of inspectors from various parts of the State, at the close of the 1901 inspection, shows an improved condition of the live stock over any previous year; but at present it seems that it will be necessary to

kill 1,200 or 1,300 a year; and, in justice to the farmers, it does not seem possible to lower the average price paid for each animal much below \$20 each. This means that it will take about \$25,000 a year, for the present, to pay for diseased cattle killed, leaving the other \$25,000 for the necessary expenses in examining quarantined cattle, glandered horses, keeping up the quarantine work, paying for office and laboratory work incidental to the duties of the commission, and meeting any emergency that may occur.

The cattle killed on the annual inspection either show physical evidence of disease, or appear to have tuberculosis of the udder, and are unfit animals to furnish a public milk supply. Koch's announcement that there is no danger to the public health from tuberculous cattle has aroused much interest and comment; but his opinion was by no means acquiesced in by the majority of the members of the Congress of Tuberculosis in London, last July, and, until more is definitely known concerning the correctness of his views, no person of sound judgment cares to advocate the use of milk for human beings that will produce disease when fed to calves and swine.

Glanders is another serious problem to be dealt with. The total equine population of Massachusetts is about 75,000, according to the last United States census; yet, in 1901, 745 horses were killed in the State with some form of this disease, — that is, about 1 per cent. of the horses of the State were infected with it, — a condition of affairs to call for the gravest concern on the part of every horse owner, horse lover, or person who has the slightest regard for the health or wealth of the community.

Under its proper heading, this report gives more in detail the work done on tuberculosis and glanders, and also investigations made concerning blackleg or symptomatic anthrax, actinomycosis, and accounts of outbreaks of rabies and hog cholera.

FINANCIAL STATEMENT.

The following financial statement gives in detail the expenditures of the Cattle Commission during the year.

Under the provisions of chapter 408, Acts of 1899, the

Cattle Commissioners have expended, during the year ending Dec. 16, 1901, as follows : —

| | |
|--|--------------------|
| For cattle condemned, killed and found tuberculous, 1,341 head, | \$27,424 50 |
| For cattle condemned, killed and no lesions found, 21 head, | 311 00 |
| For quarantine expenses, 7 head, | 14 25 |
| For expenses of killing and burial, | 60 50 |
| For expenses of arbitration, | 7 25 |
| For salaries of commissioners, | 4,230 00 |
| For expenses of commissioners, | 1,669 05 |
| For services of agents, | 4,536 50 |
| For expenses of agents, | 1,868 57 |
| For services of clerks and stenographers, | 2,556 09 |
| For books and blanks for annual inspection, | 460 35 |
| For blanks for quarantine stations, etc, | 175 32 |
| For rent of office, ten months, | 875 00 |
| For postage, express, stationery and general office expenses, | 780 07 |
| For animals for investigating outbreak of symptomatic anthrax, | 208 76 |
| For care and keeping of same, | 170 34 |
| For examinations, tests and expert investigations on account of symptomatic anthrax, | 212 37 |
| For examinations and tests for rabies, | 100 00 |
| For other laboratory and experimental work, | 668 15 |
| For tuberculin, mallein and implements, | 280 73 |
| For expenses of quarantine stations, Brighton, Somerville and Watertown, | 2,744 63 |
| For expenses of work in the suppression of glanders, | 3,598 87 |
| For expenses of killing and burial of glandered horses, | 297 97 |
| Total, | <u>\$53,250 27</u> |

Of this amount, \$7,857.25 was paid on account of claims outstanding at the beginning of the year, leaving \$45,393.02 chargeable to the appropriation of \$50,000 for 1901, and an unexpended balance of \$4,606.98, which it is expected will be sufficient to meet all unsettled accounts.

The \$50,000 appropriated for 1900 being insufficient to meet the expenses of that year, appropriations were made by the Legislature to supply the deficiency; \$2,597.13 by chapter 122, and \$810.98 by chapter 490, Acts of 1901.

The average price paid for the 1,362 condemned cattle was \$20.36, and less than the previous year by \$1.30 per head.

Twelve head of young stock used for experimental purposes were sold at auction for \$179.25 ; the sales of hides and carcasses of condemned animals during the year amounted to \$784.03, — a total of \$963.28, which has been paid to the State Treasurer from time to time as received.

By chapter 391, Acts of 1901, entitled “ An act relative to the inspection and branding of the carcasses of animals slaughtered for human food,” the Board of Cattle Commissioners is required to design and furnish to the board of health of any city or town requiring the same the stamps or brands necessary for carrying out the provisions of the act. After consulting with the United States Bureau of Animal Industry, and the examination and comparison of several styles, a simple and effective design was adopted ; and 282 branding stamps have been furnished to the boards of health of 222 cities and towns

TUBERCULOSIS.

The principal item of expense in conducting the operations of the Cattle Commission is that incurred in dealing with bovine tuberculosis, because a greater number of animals are examined for this disease than any other. Animals that are condemned and killed are paid for ; and it is necessary to keep up a quarantine against cattle coming from other States, in order to enforce regulations requiring all neat stock brought in for dairy or breeding purposes to be tested with tuberculin, to be sure that they are free from disease.

The management of bovine tuberculosis, as in previous years, may be divided under three general heads : —

First. — The maintenance of quarantine regulations against other States, requiring that all cattle imported into Massachusetts for dairy or breeding purposes shall be free from tuberculosis, the condition of health being based upon their being able to pass a tuberculin test.

Second. — That portion comprised in the work of the inspectors of animals, in their annual examination of herds and premises, reporting upon their condition, quarantining animals that show manifest symptoms of disease, which are

examined then by agents of the Board and appraised and killed by them if their condition demands it.

Third. — Testing with tuberculin entire herds, at the request of the owners, to determine which animals are infected and which are healthy, with a view to entirely eradicating tuberculosis from the herd.

First. — The maintenance of quarantine regulations. All persons bringing cattle into Massachusetts must have a permit from the Cattle Commissioners, except for those coming to the stock yards at Brighton, Watertown and Somerville, which are considered quarantine stations, and are in constant charge of a member of the commission.

All cattle except calves under six months old and beeves for immediate slaughter must be tested with tuberculin by a veterinarian acceptable to the Board, at the expense and risk of the owner, either before shipment or after arrival at their destination. Cattle brought to the stock yards are identified and released by the commissioner in charge, upon certificate of tuberculin test; the animals are identified by an ear tag furnished by the commission; the number on the tag must agree with the number on the certificate. Animals that have not been tested, upon arrival at the stock yards are held and tested by the Cattle Commission, and any that fail to pass the test are held for a week and retested; if an animal reacts a second time, it is deemed to be tuberculous, and is killed. Formerly, all animals that reacted the first time were killed, but some that gave an apparent reaction on the first test were found to be free from disease on post-mortem, and the State had to pay for them. Under the present system, a creature that reacts to the second test is invariably found to be tuberculous on autopsy.

Receipts of Stock at Brighton, from Dec. 15, 1900, to Dec. 15, 1901.

| | |
|--|--------|
| Maine cattle, | 9,837 |
| New Hampshire cattle, | 1,987 |
| New York cattle, | 673 |
| Rhode Island and Connecticut cattle, | 229 |
| Massachusetts cattle, | 11,366 |
| Western cattle, | 79,071 |
| Sheep, | 43,763 |

| | |
|--|-----------|
| Swine, | 1,196,731 |
| Veal, | 39,229 |
| Cattle released on certificates, | 8,416 |
| Cattle tested, | 3,901 |
| Cattle released after test, | 3,888 |
| Cattle condemned after test, | 13 |
| Cattle in stock barn, | 18,682 |

*Receipts of Stock at Somerville, from Dec. 15, 1900, to
Dec. 15, 1901.*

| | |
|--|---------|
| Maine cattle, | 1,147 |
| New Hampshire cattle, | 5,025 |
| Vermont cattle, | 4,886 |
| Massachusetts cattle, | 3,507 |
| New York cattle, | 496 |
| Western cattle, | 29,314 |
| Sheep, | 352,766 |
| Swine, | 18,126 |
| Veal, | 55,053 |
| Cattle released on certificates, | 936 |

All cattle not having certificate of test have been tested at Brighton by the commission, and are included in the Brighton report.

*Receipts of Stock at Watertown, from Dec. 15, 1900, to
Dec. 15, 1901.*

| | |
|--|---------|
| Vermont cattle, | 5,404 |
| New Hampshire cattle, | 5,201 |
| Massachusetts cattle, | 2,929 |
| New York cattle, | 60 |
| Western cattle, | 51,739 |
| Sheep, | 398,032 |
| Swine, | 231,639 |
| Veal, | 59,036 |
| Cattle released on certificates, | 6,492 |
| Cattle tested, | 189 |
| Cattle released after test, | 181 |
| Cattle condemned after test, | 8 |

Total Stock received at the Three Stations.

| | |
|-------------------------------------|-----------|
| Cattle, | 212,871 |
| Sheep, | 794,561 |
| Swine, | 1,446,496 |
| Veal, | 153,318 |
| Released on certificates, | 15,844 |
| Tested at stations, | 4,090 |
| Released after test, | 4,069 |
| Condemned after test, | 21 |

The amount of stock received at the quarantine stations is larger than in 1900, not only in regard to cattle, but also sheep, swine and veal.

Of the nearly 20,000 cattle released on certificates, and after being tested at the stations, nearly all were milch cows for the local markets. In 1896, there were 501 cattle tested at the stations, of which number 18, or 3 $\frac{3}{5}$ per cent., were condemned as tuberculous. In 1900, 633 were tested, of which number a little over 1 per cent. reacted. During the past year (1901) 4,090 were tested and 21 reacted, — about $\frac{1}{2}$ of 1 per cent.

Since March 1, 1901, all cattle tested at the stations have been tagged, and a record kept of their test and tag numbers. Also, a copy has been sent to the Bureau of Animal Industry, Washington, in return for which it has furnished all the tuberculin used, thereby saving the State several hundred dollars. This work has been done without extra cost, being done by the commissioner in charge and his assistants.

By comparing the number of cattle tested the past year with those of previous years, it seems as if the time will soon come when *all* cattle brought to these markets will be tested *after* arrival, as this branch of the work is constantly on the increase. The figures given show a constant increase in the number tested, and also a constant decrease in the per cent. of tuberculous animals; which decrease is thought, as was said in the last annual report, to be largely due to the care exercised by the drovers in buying cattle for these markets, also to the good work done in the past few years by the Cattle Commission of Vermont.

Report of Cattle brought into State during the Year, to Points Outside the Quarantine Stations at Brighton.

During the year 1901, 614 permits were issued to bring animals into Massachusetts, 38 of which were not used. On the balance, the following cattle were brought in:—

| | |
|--|-------|
| For dairy and breeding purposes, tested before shipment, . . . | 3,786 |
| For dairy and breeding purposes, tested after shipment, . . . | 1,761 |
| Calves under six months old, requiring no test, | 58 |

| | |
|---|-----|
| Cattle returned from out of State pastures, | 599 |
| Cattle to be pastured and returned to New Hampshire, | 3 |
| Cattle to be pastured and returned to Vermont, | 9 |
| Cattle to be pastured and returned to Rhode Island, | 20 |
| Cattle to be pastured and returned to Connecticut, | 34 |

Sixty permits were for cattle for immediate slaughter, 18 being for a carload or more weekly, and 2 for a carload or more monthly. On these permits, a great many cattle were brought in for beef, the exact number not being recorded. Five permits gave the privilege of bringing in cattle to be fattened and sold for beef later, 2 allowed herds to be driven back and forth daily between Connecticut and Massachusetts, 3 allowed cattle to pass through the State, and 8 gave owners the privilege of taking cattle to other States for exhibition at fairs and returning them. Permission was also granted to bring in a yoke of oxen, to be driven through various cities and towns, for advertising purposes.

Besides the above, railroad agents, local inspectors and others have reported 502 cows and 3 bulls brought in without permission ; but they have all been looked up and tested.

It is believed that most of the testing of veterinarians is now honestly done ; but there is a temptation to fraud in carrying out these regulations, and there are probably occasional instances where cattle are not honestly tested. When a veterinarian is found to be doing dishonest or uncertain work, his tests are thenceforth refused. A few laymen also test cattle, who are proficient in the work, whose tests are accepted by the commission. In fact, an honest layman who understands applying the test is to be preferred to a dishonest veterinarian. An honest test in every instance might be obtained in one of two following ways. One is to test cattle in all cases after arrival at destination, at the cost of the State. This would add to the annual expense of maintaining the Cattle Commission, and for that reason is objectionable. The other is to arrange to have the Bureau of Animal Industry of the United States Department of Agriculture test all dairy and breeding cattle used in interstate commerce. This desirable condition of affairs may be brought about in time.

Bulletin No. 32 of the United States Department of Agriculture, Bureau of Animal Industry, by Dr. D. E. Salmon, chief of the Bureau, upon the "Tuberculin Test of Imported Cattle," is a justification of these requirements of the United States government, and emphasizes the importance of insisting that cattle imported from foreign countries into the United States shall be free from tuberculosis, in order to protect live stock in localities where the disease does not exist; not only on account of the dangers to our own population from the use of products from tuberculous animals, and the pecuniary losses to farmers occasioned by this disease, but also to protect our foreign markets for beef and pork, as it would injure the sales of these exports in the markets of the world if we had the reputation of having this scourge prevail extensively among our cattle and swine. What he says in this bulletin is as applicable to one State as to the United States; and the Massachusetts Cattle Commission feels that it is only a proper course to pursue, as part of the work in endeavoring to eradicate tuberculosis from the herds of the Commonwealth.

The second division of the work in connection with tuberculosis is that comprised in the annual inspection made by the inspectors of animals, as provided for in section 29, chapter 408, Acts of 1899. This inspection was ordered in October this year, as it was last. The following table* shows the results of the examinations made by the inspectors, the number of cattle quarantined by them, and the disposition made of the animals by the commission :—

* The full table, showing returns by towns, will be found in the separate report of the Cattle Commissioners.

| <i>Summary.</i> | | | Increase over 1900. | Decrease under 1900. |
|--|---------|--|------------------------|-------------------------|
| Number of herds inspected, . . . | 33,623 | | 623 | — |
| Number of cows inspected, . . . | 181,739 | | 634 | — |
| Number of bulls inspected, . . . | 6,463 | | — | 449 |
| Number of oxen inspected, . . . | 2,104 | | — | 295 |
| Number of young cattle inspected, . | 61,096 | | — | 3,756 |
| Total number of cattle inspected, . | 251,402 | | — | 6,866 |
| Number of sheep inspected, . . . | 30,908 | | — | 1,503 |
| Number of swine inspected, . . . | 80,426 | | 6,395 | — |
| Number of stables inspected, . . . | 33,623 | | 603 | — |
| Number of stables improved since last report, | 884 | | — | 778 |

The above summary gives an idea of the vast amount of work done by the inspectors in the various cities and towns, and the results accomplished. It will be noticed that the number of herds and premises inspected in 1901 exceed the number in 1900, but that there is a decrease in the number of neat cattle kept, of 6,866. This decrease is among young cattle, bulls and oxen, while there is a slight increase in milch cows. This indicates that the high price of grain and hay has caused the farmers to convert animals that are not producing anything into beef; and more cows are kept, because the higher price of milk has led to keeping more animals that produce a little revenue.

While it is more difficult for the inspectors to make a fall inspection in October and November, yet it is undoubtedly the best time to make it; as badly diseased animals are killed off in the autumn, that would otherwise contaminate many others if they were closely housed with them during the winter. While but a single inspection is made during the year, the autumn is unquestionably the best time to make it. A better idea of the premises upon which animals are kept and the sanitary surroundings could be formed if the inspection could be made at the time of year when all the cattle are housed, and it would be easier for the inspectors to make their examinations when the cattle are all in the stables than when they are running in the fields; but, as a safeguard to the health of the creatures, it is certainly best to see that only those in apparent health are allowed to go into winter quarters together.

The third division of the work of eradicating tuberculosis is testing entire herds, at the request of the owner. Very little has been done in this direction during 1901, as the Cattle Commission felt that no expense should be indulged in that its appropriation did not warrant, and that its first obligations after attending to glanders, rabies, and investigating further symptomatic anthrax, were to owners of badly diseased cattle quarantined by the local inspectors. Only 5 herds were tested, and these on the condition that the owner accepted the hide and carcass of every reacting animal that passed as fit for beef, the State paying only for the badly diseased, and furnishing tuberculin and the agent to conduct the test. The total number of animals in the 5 herds was 75, of which 23 were killed; but only 7 had to be paid for by the State, as the others were so slightly infected as to pass as fit for beef. The expense of this work was not very great to the commission. Quite a number of farmers who lose an animal from time to time would like the State to assist them in eradicating tuberculosis from their herds, but most of these applications have to be denied, for lack of funds to meet any such expenditures. A special appropriation of \$25,000 has been suggested for such work, as it would undoubtedly greatly assist in diminishing the amount of tuberculosis among cattle. It is possible for any farmer to test his cattle and find out the condition of his herd; but few can afford the loss that would be sustained under present farming conditions, unless the State assisted.

GLANDERS.

During the year 1901 glanders and farcy have continued to prevail extensively, more cases of horses suspected of having this disease having been reported to the Cattle Commission than in any year in its history. Methods of obtaining information have been perfected during the past two or three years, so that probably nearly all the cases occurring in this Commonwealth are now reported; but beside this there must be a slight increase. The efforts of the commission in obtaining as full reports as possible have resulted in its being able to present the true condition of affairs as it is. The losses to the horse owners of Massachusetts from this

cause must be very heavy every year, to say nothing of the danger to human beings who are brought in contact with animals infected with this disease, and no means should be neglected towards doing everything possible for its eradication.

The estimated value of the horses killed in Massachusetts as having glanders or farcy is \$67,646, based upon the following figures: the average value of 184 horses, killed by order of the Board, as having glanders and farcy, estimated at time of condemnation by a member of the commission or an agent, was \$90.80; the value of 745 horses killed as having this disease, at the same average value, would amount to \$67,646. While this is a high estimate, many of the horses killed with the owners' consent, without examination by the commission, probably being worth much less than the average, yet the total loss to horse owners of the State must be nearly \$60,000.

From Dec. 15, 1900, to Dec. 15, 1901, 908 cases of suspected glanders or farcy have been reported to the commission, in 129 cities and towns; of these, 745 were killed or died and 163 were found free from this malady, as compared with 849 cases in 1900, in 128 cities and towns, of which 700 were killed and 149 were found to be uninfected. Of the animals destroyed, 4 were mules and the rest horses.

In dealing with glanders, it seems to be much easier to eradicate it in the smaller cities and towns and in the sparsely settled rural districts than in the larger cities and their surroundings. In the former places the watering troughs are closed, the blacksmiths urged to whitewash their shops, and any diseased horses killed and their stables disinfected, and suspicious ones kept under observation. But in larger cities, such as Boston, Worcester and Fall River, it is ever present, and these places serve as centres of infection to keep the disease from disappearing entirely in surrounding cities and towns. For instance, in places adjoining Boston many of the cases occur among horses owned by teamsters and expressmen, which go back and forth over the road to the city nearly every day. Of the 17 cases in Newton during the past year, 9 of the animals killed were owned by five different express companies.

An alphabetical list of towns does not convey much of an idea of the prevalence of the disease in certain localities, but the table shows a marked decrease in Fitchburg and the adjoining towns. It also seems to have decreased very considerably in the Connecticut valley. In Berkshire County there is more than for several years ; it occurred in Pittsfield, Adams and Williamstown, although all combined the cases only number 8. There seems to be a tendency toward an increase in the Merrimac valley. Worcester shows quite an increase over last year, but it does not prevail there now to the extent it did four or five years ago. In most of the cities adjoining Boston on the north there is a decrease ; in Cambridge, Somerville, Chelsea, Everett and Malden it is quite apparent. Lynn shows a slight increase. South of Boston, in Watertown, Newton, Dedham and Needham, it has increased ; while beyond these places, in Waltham, Wellesley, Dover, Westwood and Medfield, it shows a decrease. Along the south shore there is a marked abatement ; the towns of Weymouth, Hingham, Cohasset and Hull seem to be free. The 2 cases reported from Hingham properly belong to Boston. The horses were sent there by a Charlestown firm of contractors, and were used to load gravel on scows ; they were entirely by themselves, and never came in contact with Hingham horses in any way. The most serious outbreak of the year was in Middleborough and adjoining towns. There was also somewhat of an outbreak in Framingham, and a number of cases also occurred in Natick and Brookline ; but in the two towns last named the disease was in each instance confined chiefly to one stable. A small outbreak also occurred in Deerfield. In connection with the Middleborough outbreak, glanders has prevailed extensively in Brockton, extending through East Bridgewater, Halifax, Middleborough, Carver and Rochester to New Bedford. Many of the infected horses in the towns between Brockton and New Bedford were owned by lumbermen and box manufacturers. It is hoped that the outbreak is now under control. Fall River shows a slight decrease, but the number of cases is practically the same as usual. A few cases occurred on Cape Cod, — more than for several years.

Some of the trouble on the Cape was called to the attention of the commission by a horse killed in Dedham. It was found that this animal had only been there a few days, and was brought up from the Cape. An agent was sent to the stable on the Cape where the diseased animal brought to Dedham had been boarded, and two horses were found there with glanders, and were killed.

In some towns where glanders and farcy have occurred many of the animals were not owned by the towns people, but by contractors engaged on public work. For example, the outbreak in Sterling in December, 1900, and January, 1901, was among horses owned by a contractor employed on the metropolitan water works. The same is true to a certain extent in Framingham, several of the animals being owned by a firm of contractors on the metropolitan water works. In Hyde Park 5 of the horses killed were owned by a contractor working on a section of the metropolitan sewerage system.

Mallein has been employed in the eradication of glanders more extensively than in any previous year. While it does not seem certain enough as a diagnostic to warrant killing animals that react but which show no physical symptoms of disease, yet it seems to be generally believed that an animal that does not react is free from glanders, and that it also has a curative effect on incipient cases, and may also act as an immunizing agent. Many of the animals coming under the head of negative cases were treated with this agent. All the horses in a stable where there was glanders in several instances have been tested with mallein; any animals that reacted were retested in a month, and if any reacted they were again tested in another month, until they ceased to react. Those that failed to react on the first test were considered healthy.

This method has been tried with apparent success in a contractor's stable in Brookline, in a stable in Natick, among the horses of the contractor spoken of in Sterling, and in a stable in Fitchburg, where 1 horse was killed and the 3 stable companions released after failing to react on the second test. It was also tried in Winchendon, where 3

horses were killed and 2 released, all owned by one firm. The stables of horses spoken of were tested early in the year, and no reports of any further trouble among them have as yet been received. The guinea pig test has also been extensively used, as in the past few years, and has continued to show its value in diagnosing doubtful cases. Male guinea pigs are inoculated into the abdominal cavity with material from discharges from the nose, or from sores on the legs or body, from horses suspected of having glanders or farcy. If the guinea pigs develop glanders, it is positive proof that the horse is suffering from some form of the disease; and many chronic cases are now killed in the early stages of the malady, that in former times might have been allowed to live for years, spreading the infection among other horses wherever they went.

Additional legislation seemed necessary in regard to renderers; and a bill was passed by the last Legislature, requiring renderers to have a license from the boards of health in the cities or towns where rendering establishments are located, and providing that they must report all cases of contagious diseases among domestic animals received at their establishments. The following cases of glanders and farcy have been reported to the commission by renderers, as given in the subjoined table: —

| | Number of Reports. | Number of Cases. | Number in Boston. | Number out of Boston. | Number outside of Boston not reported previously. |
|--|--------------------|------------------|-------------------|-----------------------|---|
| Guy N. Barnes Rendering Company, Fall River. | 19 | 32 | — | 32 | — |
| Bartlett & Holmes, Springfield, . . . | 2 | 2 | — | 2 | 1 |
| Butchers Slaughtering and Melting Association, Brighton. | 42 | 96 | 17 | 79 | 35 |
| W. C. Laurence, Brockton, | 8 | 10 | — | 10 | 5 |
| Lavery Fertilizer Company, Amesbury. | 1 | 2 | — | 2 | — |
| Lowe Bros. & Co., Fitchburg, | 6 | 7 | — | 7 | — |
| Lowell Rendering Company, Lowell, . | 2 | 2 | — | 2 | — |

| | Number of Reports. | Number of Cases. | Number in Boston. | Number out of Boston. | Number outside of Boston not reported previously. |
|---|--------------------|------------------|-------------------|-----------------------|---|
| Jas. E. McGovern, Lawrence, . . . | 5 | 6 | — | 6 | 2 |
| McQuade Bros., Auburn, | 2 | 2 | — | 2 | 1 |
| Muller Bros., North Cambridge, . . | 22 | 68 | — | 68 | 23 |
| New Bedford Product Company, New Bedford. | 9 | 10 | — | 10 | 5 |
| Parmenter & Polsey Fertilizer Company, Peabody. | 18 | 25 | — | 25 | 10 |
| N. Ward & Co., Boston, | 46 | 162 | 125 | 37 | 10 |
| E. J. Whitman Rendering Company, Dracut. | 3 | 4 | — | 4 | 2 |
| Totals, | 185 | 428 | 142 | 286 | 94 |

It will be seen from the above table that reports have been made by 14 rendering companies, the total number received being 185, including 428 animals. Those in Boston number 142; as the Boston board of health has full charge of glanders and farcy in the city limits, the commission has nothing to do with these cases; the number of cases reported includes Boston simply to show the condition of affairs for the whole State. Outside of Boston, 286 cases were reported by the rendering companies; of these, 94 had not been previously reported to the Board, and most of them were not subsequently reported. In these cases the inspector of animals in the town where each such case occurs is immediately notified to see that the owner of the horse has properly disinfected his stable, and, if any horses are kept there, to examine them and see if they are healthy. This system is of great assistance in the endeavor to check the spread of the disease. The renderers' reports do not include Mr. Bartlett's establishment in Worcester, as he reports all the cases he receives directly to Mr. Herrick, and the horses condemned by order of the commission in that city are killed there.

No authentic cases of glanders in man have been called to

the attention of the Board during the past year, although the increase among horses seems to make the danger to man greater. An interesting case occurred in Middleborough. A mare with farcy was killed, having a foal a few days old at foot; the mare had farcy for some time during the latter part of her pregnancy; the foal was weaned on to cow's milk, as it showed no evidence of disease, and now, at between the ages of two and three months, appears to be perfectly healthy. Judging from this case, at the present time the old-fashioned idea that glanders and farcy is congenital seems to be erroneous.

The law provides a penalty for any one removing, transporting or selling an animal with a contagious disease, if the person knows or has reasonable cause to believe such to be the fact. Persons disposing of glandered horses always deny that they knew or suspected the existence of a contagious disease, and it is, therefore, useless to prosecute cases unless proof is forthcoming to show that there was good reason for believing the presence of glanders and farcy. Two cases have been prosecuted during the year, one in Fitchburg, where a man disposed of a horse after being informed that an agent of the commission was notified to come and see it. The case was placed on file, and costs assessed on the owner of the horse. It was not a strong case. The other prosecution was in Worcester, where two men were fined \$50 each for attempting to dispose of a glandered horse.

When we consider that in 1898 only 1,380 cases of glanders were reported in Great Britain, 138 in Belgium and 17 in Denmark, it can be more readily realized what a large number 745 is for a State the size of Massachusetts, — probably more than any other State in the Union, — and how important its eradication is. It is not only a heavy tax on the horse owners of the State, but a menace to the public health, as occasionally a person becomes infected from a glandered horse, and succumbs to this loathsome disease.

BLACKLEG, OR SYMPTOMATIC ANTHRAX.*

(*Quarter Ill of the English; Rauch-brand of the Germans; and the Charbon Symptomatique of the French.*)

During the season of 1901 there has been very little trouble from blackleg reported to the Cattle Commission. In localities where it prevailed extensively in the summer of 1900 no cases occurred; the few instances where it has been found have been, as a rule, in places where it was not observed the year before.

Early in the season the Board felt that a further study of the disease which prevailed in Hubbardston and the adjoining towns during the summer of 1900 should be made, in order to ascertain as far as possible its nature, and also to determine means for its prevention if it should again appear. In the report of the Cattle Commission for 1901 (work done in 1900) it will be remembered that an inoculation experiment was tried upon a two-year-old heifer, four cubic centimeters of a three-day-old bouillon culture being injected into the connective tissue under the skin on the shoulder, with a hypodermic syringe, without producing serious results, beyond causing a rise in temperature, a slight loss of appetite and a swelling at the point of inoculation, which gradually subsided. It is safe to assume that an animal thus protected would be immune if introduced into an infected pasture; but it was not fair to come to the conclusion that all animals thus treated would suffer as little inconvenience as this heifer, and in some instances such experiments might result fatally; it was, therefore, decided to continue the experiment on a larger scale, in order to decide whether young cattle could safely be inoculated with an active organism of the disease, without producing serious or fatal consequences to some. Accordingly, in the month of April a dozen young creatures were purchased, ranging in age from six months to two years old. All were tested with tuberculin at the time of purchase, in order to be sure that they were free from disease. The young animals were bought

* A fuller description of this disease will be found in the separate report of the Cattle Commissioners.

in Brighton by Mr. Dennen and sent to an empty barn at Bussey College, kindly placed at the disposal of the commission by the courtesy of Dr. Theobald Smith. The bacteriological work has been done in Dr. Smith's laboratory by him, and the Board is greatly indebted to him for his advice and assistance. Much of the clinical work has been done by Dr. A. W. May of Jamaica Plain, who has been of great assistance in aiding in this portion of the experiments.

The following circular, sent out by the Bureau of Animal Industry, describes the *modus operandi* :—

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY, WASHINGTON, D. C., April 21, 1900.

The accompanying paper, prepared by Victor A. Nörsgaard, chief of the Pathological Division, entitled "Directions for the use of blackleg vaccine," is respectfully recommended for publication as Circular No. 23 (second revision) of this Bureau. Information of this character first appeared as Circular No. 21.

Very respectfully,

D. E. SALMON,

Chief of Bureau.

Approved: JAMES WILSON,

Secretary of Agriculture.

DIRECTIONS FOR THE USE OF BLACKLEG VACCINE.

[By VICTOR A. NÖRGAARD, *Chief of Pathological Division, Bureau of Animal Industry.*]

The blackleg vaccine, as prepared by this Bureau, consists of a brownish powder, which is put up in packets containing either ten or twenty-five doses each. To prepare this powder in such a way that it may be injected hypodermically, it is necessary to obtain certain implements, which, together with the hypodermic syringe, are known as a vaccinating outfit. This consists of a porcelain mortar with pestle, a small glass funnel and a measuring glass. For filtering the vaccine we have found absorbent cotton to be most suitable. Fig. 1 is an illustration of the vaccinating outfit recommended by this Bureau. All of the utensils, including the hypodermic syringe and a package of absorbent cotton, are fitted in a strong polished oak box, which, by means of an adjustable wire loop, serves also as a support for the funnel when the vaccine is filtering. The syringe, two hypodermic needles and an extra glass barrel are packed in a separate metal box, which is inclosed in the oak box.

The syringe (fig. 2) has a capacity of five cubic centimeters, and the piston is graduated from one to five, each division being subdivided with half and quarter notches. The screw regulator (fig. 2, *sr*) may be placed at any mark on the piston, thus insuring that the animal to be vaccinated receives only the exact dose intended for it. The plunger (fig. 2, *pl*) is made of rubber; it should fit air-tight in the glass barrel, and still be susceptible of being moved up and down smoothly. By means of the milled head (fig. 2, *mh*) at the free end of the piston the rubber of the plunger may be expanded or contracted simply by screwing the head to the right or left. By this arrangement a close fit

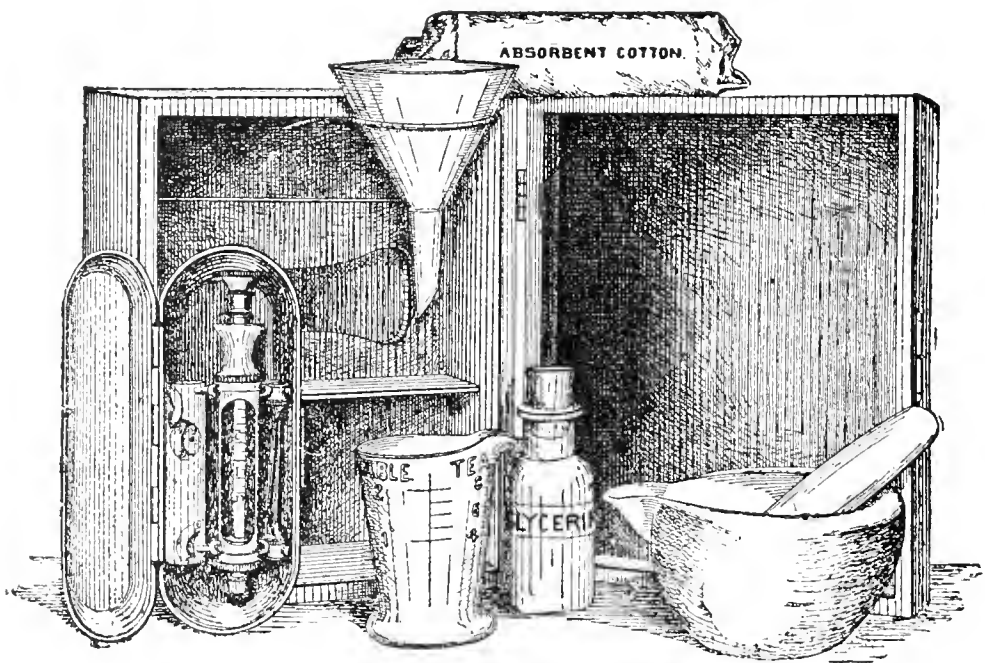


FIG. 1. — Vaccinating Outfit.*

may always be obtained without taking the syringe apart. If the plunger should become dry, or for other reasons not move smoothly up and down in the barrel, it is necessary to unscrew the milled cap *c* and pour a drop of glycerine into the barrel. For this purpose a small bottle of glycerine is furnished with each outfit; oil or grease should never be used, as these substances destroy

* A complete vaccinating outfit, including hypodermic syringe, can be obtained from Z. D. Gilman, 627 Pennsylvania Avenue, N. W., Washington, D. C., for the sum of four dollars. The outfit is prepared by the firm named in accordance with the plans of this Bureau, to meet the temporary demand that may arise in introducing this vaccine. If vaccination should be extensively adopted as a preventive of this disease, similar outfits will no doubt be for sale by other dealers furnishing this class of supplies. Until this may be the case, the unusual course of mentioning a dealer by name in a department publication is followed.

the rubber. Extra washers to be placed inside of the cap at each end of the glass barrel are also to be found in the syringe box. It is of the greatest importance that the syringe be perfectly tight, in order that not a drop of vaccine may escape except through the

point of the needle. If a leak occurs, unscrew the cap of the syringe, withdraw the glass barrel and replace the old washers with new ones. In order to prevent the plungers and washers from drying out, the small loose cap *lc* should always be tightly adjusted to the peg *p* when the syringe is not in use. The hypodermic needles should be kept very sharp at the point, in order to pass easily through the skin, and when not in use should have a fine brass wire passed through each, to prevent rusting on the inside.

Whenever the point of the needle gets blunt, it becomes very difficult to pass it through the skin, the fingers of the operator become sore from attempting to force it through, and frequently the needle either bends or breaks. It is, therefore, of importance to have a small oilstone at hand on which to sharpen the point of the needle. Before using the syringe, it should be tested thoroughly with pure water, to ascertain that it is in perfect working order. To this end, fill

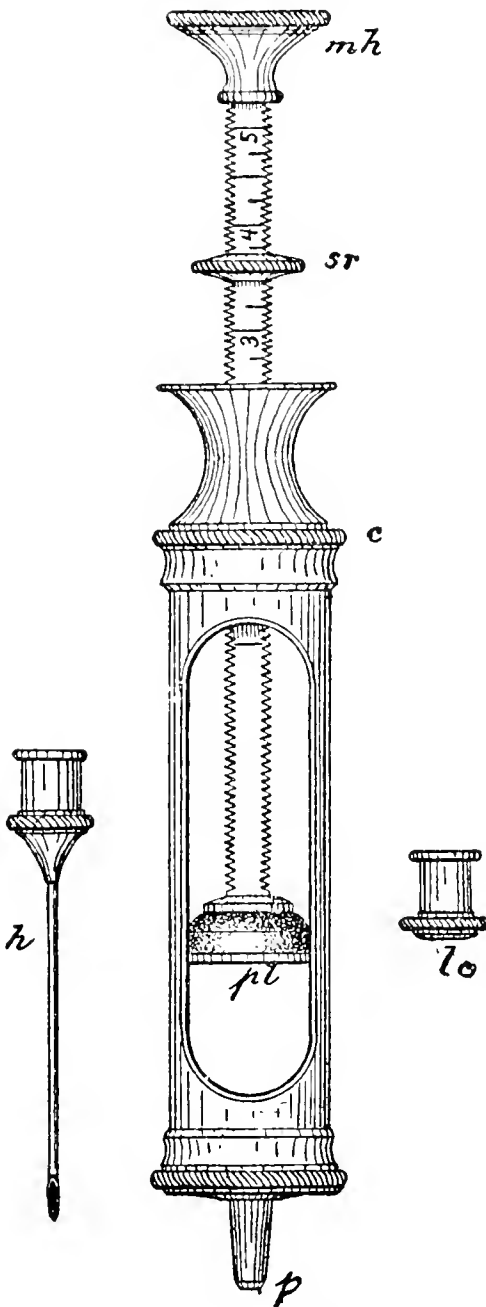


FIG. 2. — Hypodermic Syringe.

the syringe slowly by withdrawing the piston. If the syringe is perfectly tight it should fill completely; if it contains air bubbles, turn it with the point upward and press the piston until the water comes out of the point, then refill. The same precaution must be taken when filling the syringe with vaccine.

Sterilization of Utensils.

Before preparing the vaccine, all the utensils, together with the syringe, must be sterilized thoroughly. This is done by putting the mortar, pestle, measuring glass, funnel and needles in a pan of cold water, placing all over the fire. After boiling for ten minutes, the pan with the contents should be allowed to cool off slowly; then remove the utensils from the water and wipe them dry with a clean linen cloth which has been previously boiled. When the vaccine has been prepared, the utensils should be cleansed thoroughly and replaced in the box. After injection, the syringe and needles must be washed with a five per cent. solution of carbolic acid, carefully wiped, and the brass wire adjusted in the needles.

Preparation of the Vaccine.

Place the contents of one packet of the vaccine in a porcelain mortar and add a few drops of boiled water. (The water must have been previously boiled and allowed to cool.) Work the powder thoroughly with the pestle, and then add, little by little, as many cubic centimeters of water as the packet contains doses. As the syringe contains exactly five cubic centimeters, it may be used for measuring the water. A packet containing ten doses of the vaccine should be dissolved in two syringes full of water, and one containing twenty-five doses in five syringes full. Care should be taken that the syringe is full every time. To filter the vaccine, place the wooden box on end, as shown in fig. 1, and adjust the wire loop in the two eyelets. Place in the funnel a small piece of absorbent cotton, and press it lightly into the upper end of the neck, sufficient to keep it in place; moisten the cotton with a few drops of boiled water, and let it drip off. Stir the mixture in the mortar thoroughly, and, before it has had time to settle, pour it into the funnel under which the measuring glass has been placed. The solution should not be perfectly clear. If this is the case, the cotton has been pressed too closely into the neck of the funnel. The straining is done simply to prevent the coarser parts of the powder, which are suspended in the solution, from clogging up the needle when the vaccine is injected; and, as the effectiveness of the vaccine depends upon the number of attenuated spores in the solution, it is obvious that a perfectly clear solution can not be as effective as one which is cloudy. It is, therefore, of the greatest importance that much time and care be spent in grinding the vaccine powder as fine as possible before the bulk of the water is added, as otherwise the greater part of the germ-carrying particles

are left on the cotton, instead of passing through it. If too much water is added at first, it is almost impossible to grind the powder, and it becomes necessary to place the mortar, with its contents, in a warm and airy place, in order to allow some of the water to evaporate. Only sufficient water should be added to the powder to make it form a paste, in which form it is easy to grind it extremely fine.

When a large number of animals are to be vaccinated at the same time, three or four packets of the vaccine may be dissolved at once, care being taken that the requisite amount of water is used, as otherwise the solution will be too strong or too weak. When the vaccine is prepared at home, a small sterilized medicine bottle may be substituted for the measuring glass under the funnel. The stopper of this bottle, if cork, must have been thoroughly soaked in boiled water. The vaccine is carried in the bottle to the place of operation, where it may be transferred, a little at a time, to the measuring glass; from this it may conveniently be drawn into the syringe. In doing this it is of importance to remember that, when standing for some time, a slight sediment will form at the bottom of the vessel or bottle, and the vaccine should therefore always be well shaken or stirred before the syringe is filled. When some time elapses between the vaccination of two animals, and the syringe still contains one or more doses of vaccine, the operator should turn the syringe up and down frequently to insure an even distribution of the germ-carrying particles throughout the vaccine.

No more vaccine should be prepared at one time than can be used the same day. While the vaccine powder will remain unchanged for some months, the solution deteriorates very quickly, and must be used within twenty-four hours after it is made.

Animals to be vaccinated.

Calves, as a rule, should not be vaccinated until they are six months old. Under this age they are practically immune from blackleg, and it has been claimed that when vaccinated before they are six months old they are liable to lose the artificial immunity induced by means of vaccination, and become susceptible again. Animals more than two years old are seldom affected, and the mortality among them is so small as to make vaccination unprofitable. It is the calves between six months and two years old which should be vaccinated. Vaccination has no ill effect on calves under six months old; but it should be a rule that when very young animals are vaccinated they should be revaccinated before the beginning of the following blackleg season.

The time to vaccinate depends largely upon circumstances. In nearly every part of the country where blackleg is known there is a distinct blackleg season, and the proper time to vaccinate is just before the arrival of this season. Every practical ranchman and farmer, as a rule, knows when to look for blackleg; and, as the disease may appear a little sooner or later, according to climatic conditions, it is always better to vaccinate two or three weeks before the beginning of the blackleg season. In some parts of the country it is not unusual that the calves commence dying when only four months old, while in others they seldom become affected until they are eight months old. It is, therefore, much a matter of judgment when to vaccinate, and what should constitute the minimum age at which the calves should be treated.

Vaccination and castration should not be performed at the same time. Castration is always a severe operation, and in some cases decreases the vitality of the animals to such an extent as to make them unable to resist the effect of the vaccination. The same principle applies to all surgical operations (castration, spaying, dehorning, etc.), as well as to those cases where the constitution of the animal has been impaired from injuries external or internal.

Ten days to two weeks should be allowed to pass after vaccination before any surgical operation is undertaken, and, if performed before vaccination, ample time should be allowed for the part to heal and for the animal to regain its lost strength.

The Dose to be injected.

Animals one year old or over are injected with a full dose of vaccine, — that is, one cubic centimeter of the solution. Under this age the dose may be reduced to one-half or three-fourths of a full dose, according to the size and development of the animal. Less than one-half a dose should never be injected. In determining the dose for each animal, more consideration should be given to the size and development of the animal than to its exact age.

How to operate.

When the animals to be vaccinated are gentle, and accustomed to being handled, vaccination may be performed on the standing animal. Range cattle or other half-wild animals must be thrown or secured, as in a dehorning chute. The most convenient place to inoculate is on the side of the neck, just in front of the shoulder, where the skin is loose and rather thin. If the animals are secured in a dehorning chute, it is easier to vaccinate them on the side of the chest, just behind the shoulder.

All animals should be vaccinated on the same side, and marked in such a way that they may be easily recognized. The best way to mark them is to use a small branding iron in the shape of a V, or to fasten a metal tag in the ear. As calves which have been vaccinated for blackleg frequently command a higher price than the unvaccinated calves, it is of importance that they be plainly marked.

When the animal is secured, fill the syringe with vaccine, and ascertain that it contains no air bubbles; then insert the needle by grasping a fold of the loose skin between the thumb and forefinger of the left hand, and pushing the needle through the skin. The operator now adjusts the peg of the syringe tightly in the cap of the needle and injects the dose, which has been previously limited by the screw regulator on the piston. The needle is then withdrawn without detaching the syringe, and, to prevent any of the vaccine from escaping through the hole of injection, the skin is pressed tightly around the receding needle. The latter is then detached, the regulator screwed back to its proper place, according to the size and age of the animal to be next vaccinated.

When a large number of cattle are to be vaccinated, it is of importance to have a sufficient number of assistants, as otherwise the process becomes exceedingly tiresome and fatiguing, both to the operator and to the assistants. The herd to be treated is confined in a pen, from which a small number, from five to ten, according to the number of assistants at hand, are driven into a smaller pen, where the assistants throw them and hold them down. Very wild range cattle must be lassoed; but graded or fine stock, being less unmanageable, should be seized by the head and thrown. The first method requires a larger pen, but when the assistants are skilful in handling the lasso, it is by far the quickest way. The animals should all be thrown on the same side. One assistant sits across the side of the thrown animal, with his face toward its head, and holding the upper fore leg pulled back and up. When secured in this way, it is almost impossible for a well-grown yearling to free itself.

With older and stronger animals it is safer to have two men to hold each, as an animal which succeeds in getting up before all have been injected and marked will frequently make things very unpleasant for the operator and assistants, chasing them from the pen, and necessitating a repetition of the whole process.

The operator should have an assistant insert the needle, while he himself adjusts the regulator. After inserting the needle, the assistant lifts the skin fold, presenting the cap of the needle so

that the operator may easily grasp it and attach the syringe. In this way from ninety to one hundred head of yearling calves may be vaccinated in one hour, with ten men to handle the animals and one assistant to insert the needle; but such a rate can only be maintained for a limited time without changing the men. With one set of men not more than four hundred or five hundred head should be vaccinated in one day, according to the age and size of the animals.

On many large ranches, where vaccination for blackleg is practised as regularly as branding, special vaccinating chutes (see fig. 3) have been constructed, which in principle resemble the ordinary squeezer, or branding chute. One side of the chute is hinged to the base, and may, by means of a block and tackle, be pulled over against the opposite side, thus squeezing the calves and preventing them from struggling while the needle is inserted and the vaccine injected. One of the planks in the movable side, at a proper

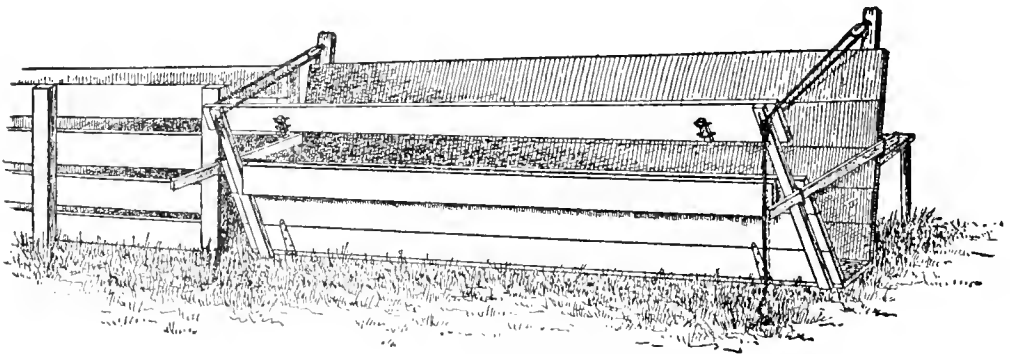


FIG. 3. — A Vaccinating Chute.

distance from the ground, is loose, and hinged to the plank below it, so that it may be opened and give the operator access to the side of the animals. The chute may be built as long or as short as desired, or may be made portable, and carried to any pasture on the ranch and connected with the stationary chutes and pens. Such a chute enables three or four men to vaccinate the same number of calves as ten to twelve men can vaccinate in the same length of time when every animal has to be lassoed or thrown.

Synopsis of Vaccination Process.

- (1) Sterilize outfit by boiling.
- (2) Place the contents of one packet in the mortar, and add a few drops of water.
- (3) Work the mixture well with the pestle.
- (4) Add two to five syringes full of water, according to the size of the packet, and stir well.

- (5) Place cotton in glass funnel, and moisten with water.
- (6) Filter vaccine into the glass or bottle.
- (7) Secure the animal to be injected.
- (8) Insert the needle through the skin.
- (9) Fill the syringe, and adjust the screw regulator on the piston. If the first animal is a yearling or older, place regulator No. 1 on the syringe (fig. 2).
- (10) Fit the peg of the syringe into the cap of the needle, and inject the dose.
- (11) Withdraw syringe and needle together. If the syringe is removed from the needle before this has been drawn out of the skin, some of the injected vaccine will flow back through the needle, and be lost. In this case the animal does not get its full dose, and will consequently be insufficiently protected.

Attention.

(1) *Cattle owners are hereby requested to report immediately all deaths from blackleg which occur within one week after vaccination. For this purpose a separate blank and return envelope (which requires no postage) are furnished with the vaccine.*

(2) *Vaccine which for any reason is not used should be returned to this office immediately, and in acknowledgment of the same a new application blank will be forwarded to the sender.*

(3) *Do not castrate or dehorn at the time of vaccination.*

The vaccine material is made by the following method, at the Lyon's Veterinary School: "Forty grammes of infected muscle are rapidly dried at a temperature of 32° C., and are intimately mixed with eighty grammes of water. This mixture is divided into twelve equal parts, which are placed on separate flat plates. These plates are put into a thermostat for six hours to dry; six plates are exposed to a temperature of 100° C., in order to produce the weaker or first material, and the remaining plates to one of 85° C., to obtain the stronger or second material. The inoculation is made in two stages, first with the weaker and afterward with the stronger material. The dried-up brown crust on the plates is used for the inoculation, and may be kept for a moderately long period." (See Hayes' "Translation of Friedberger and Fröhner," Vol. I., page 128.)

Most of the vaccine viruses in use are prepared in this

manner, or some modification of it. Kitt's method of protective inoculation, also described in Friedberger and Fröhner's work, consists in a single inoculation with a fluid culture of the organism of symptomatic anthrax, in a similar manner to that described in the experiments with the twelve young cattle given in detail in the early part of this portion of the report.*

In localities in Massachusetts where outbreaks of symptomatic anthrax are likely to occur, it would be well for farmers to have recourse to one of these methods of protective inoculation, in order to save their young animals from the ravages of this disease.

ACTINOMYCOSIS.

A few cases of actinomycosis have been reported to the commission during the past year. The most interesting of these are where the lesions occur in the udder.

Actinomycosis is caused by a fungus, the actinomyces, the name meaning ray or star-shaped fungus. It occurs in grain or its husks, said to be particularly frequent in barley, but may occur in any grain. When it finds lodgment in an abraded surface, where it is undisturbed, it grows and causes the development of a tumor composed chiefly of granulation tissue. The tumor may soften and break, discharging a purulent material, in which clumps of actinomyces may be seen with the naked eye, presenting the appearance of small specks of sand. These specks under the microscope are found to be made up of groups of actinomyces. Actinomycosis is said to be more peculiar to certain districts than others, particularly in swampy districts; it occurs frequently in the fens of Lincolnshire, and is often seen in western cattle and occasionally in the east. It is known all over Europe, and was first noticed in 1860 by two Italians, Peroneito and Rivolta. Hahn further described it in 1870, but the first exact description of the disease was furnished by Bollinger, in 1877. Harz was the first to examine the fungus botanically, and to give it the name actinomycosis

* Kitt recommends the use of but one cubic centimeter of a three days' old fluid culture of the organism.

(ray fungus). (*Vide* Hayes' "Translation of Friedberger and Fröhner.") The nomenclature, as the disease occurs in cattle, is commonly applied from the location of the lesions. If the fungus obtains access to the bones of the head, it is known as "lumpy jaw;" when it occurs in the tongue, it has been called "wooden tongue."

Actinomycosis may occur not only in cattle, but in horses, swine and man, but is very rare in the latter. In cattle, where it produces what is commonly called "lumpy jaw," the fungus first obtains entrance to the jaw bone, either upper or lower, probably when a temporary molar tooth is shed, finding lodgment in an alveolus before the permanent tooth has grown up, and in this way the tumor so well known to cattlemen originates. When the tongue is involved, it results from the actinomyces finding a resting place in a cut or scratch on this organ. Secondary growths may occur in the lungs and other localities. When the disease occurs in the udder, it must gain access to the milk duct, and finds probably an irritated surface at some point in the interior of the gland where it can develop. From time to time during the past five years the attention of the Board has been occasionally called to cows with a nodulated condition of the udder. These nodules feel like tubercles, and it is difficult to say whether the disease is tuberculosis of the udder, or not. If the cow is tested with tuberculin, and fails to react, it is certainly not tuberculosis; but she may react, and lesions of tuberculosis are found elsewhere, and the nodules in the udder are found to be actinomycotic; or in some instances, if milk from the infected quarter is examined, actinomyces may be found.

During 1901 four cases of actinomycosis of the udder in cows have come to the notice of the Board, three in Boston and one in Cohasset. One of the Boston cases was reported in April. The cow had recently calved, and otherwise was a fine animal. A tuberculin test showed her to be free from tuberculosis, and an examination of the milk revealed the presence of actinomyces in the altered material secreted by one hind quarter of the udder. The cow and calf were purchased for experimental purposes, April 23, the calf

being kept on the cow all summer. They remained at Jamaica Plain until May 22, when they were sent to Princeton and turned out with some of the young cattle used for investigating symptomatic anthrax. From May 4 to May 22 two rabbits were given some of the secretion from the actinomycotic quarter of the udder. After the cow was sent away the rabbits were killed and examined by Dr. Frothingham, but no lesions of any sort could be found on autopsy. Before the cow and calf were sent to Princeton, some of the actinomyces were separated from the milk with a centrifugalizer, mixed with distilled water, and then injected into the thoracic cavity and also into the abdominal cavity of the calf with a hypodermic syringe. The calf ran with the cow all summer in the pasture at Princeton, and thrived magnificently. In the autumn he was as large as a yearling. October 29 the cow and calf were killed at Princeton, and post-mortem examinations were made on both by Dr. Frothingham. The calf proved to be absolutely healthy; not a lesion was found in him anywhere. The cow was healthy with the exception of the udder; one hind quarter was badly diseased, the other one slightly so. From these experiments it would not appear that there was any danger from the use of milk from cows with actinomycosis of the udder.

Hayes' "Translation of Friedberger and Fröhner," page 216, says that attempts at transmitting actinomycosis from infected animals, by various European experimenters, to cattle, calves, goats, sheep, pigs, dogs, cats, rabbits and guinea pigs, have proved negative. "It is thought that the ray fungus has a pathogenic effect only in the stage of development connected with the awns of grain, and that it loses its power of transmission as soon as it has entered the animal body, on account of undergoing some form of involution (calcification, etc.). The negative results of the inoculation experiments are of great importance for elucidating the question of the transmissibility of actinomycosis from one animal to another, or from one of the lower animals to man. The foregoing considerations tend to prove that infection cannot take place in this manner."

On the other hand, secondary growths as a result of a primary infection do seem to occur in an actinomycotic animal, and cases of actinomycosis have been observed in man; therefore, until more is known, it seems only safe to forbid the use of milk from cows with actinomycosis of the udder. The occurrence of this disease in the mammary gland is an argument in favor of bedding cows with sawdust or sand in localities where the trouble is prevalent, as an infection of the udder may in time result in the ruin and loss of one or more quarters of the gland. Actinomycosis yields sometimes to treatment with iodide of potash given in the feed two or three times daily, in full-sized doses, continued for some time, and may be worthy of a trial in an attempt to cure a valuable breeding animal. It lessens the milk secretion, and causes the skin to become rough and scaly and the eyes to run. When these symptoms occur, the treatment may be suspended for a while, to be resumed later, if necessary.

TEXAS FEVER.

There has been no Texas fever in Massachusetts during the summer of 1901, similar conditions prevailing to the summer of 1900 and for the past few years, the last outbreak of this disease being in the summer of 1897. This outbreak was due to violating the rules of the United States Bureau of Animal Industry at the stock yards in Albany, cattle from an infected territory being penned in yards which were afterwards used for northern cattle. Some of the northern cattle exposed at this time were taken to Massachusetts and Connecticut, and afterwards died, but it was too late in the season for others to become infected.

The Bureau of Animal Industry requires all cars containing cattle from infected districts to bear a placard stating the fact, and such cattle cannot be yarded in pens used for northern cattle. During the months when there is no frost the Cattle Commission will not allow any southern cattle to be brought into the State except for immediate slaughter, and they must be unloaded directly from the cars into the abattoir. With the present rules and regulations of the Bureau of Animal Industry, and the legislation of Massa-

chusetts relating to Texas fever, it seems to be almost an impossibility for this malady to be any longer a source of danger to the live stock interests of the State.

RABIES.

At the time of submitting the last annual report it was stated that no authentic cases of rabies had occurred in Massachusetts for a long time, and it was hoped that the disease had disappeared from the State altogether. The last case reported to the Board that was verified by inoculating small animals was in March, 1899; but it was feared at the time of writing the report that an outbreak was about to occur in Watertown and Waltham. This proved to be the fact.

In Watertown two cases occurred Dec. 15, 1900; both were proved to have been rabid by inoculating rabbits or guinea pigs at the medical school. A third dog which used to play with one of those killed was quarantined for ninety days; at the end of this time he was healthy, and released from quarantine. December 17 two more dogs, one in Belmont and one in Waverley, were killed as rabid. The dog in Waverley was proved to have had rabies, by inoculation experiments; the other was undoubtedly mad, but was buried without obtaining the scientific proof. These cases were all reported to the Board by Dr. E. A. Madden, inspector of animals of Watertown. Jan. 2, 1901, Dr. P. F. Wallingford, inspector of animals for Waltham, reported an outbreak, probably a continuance of the one in Watertown, as the towns join each other. Two dogs were killed on this date, and another one January 9. They all undoubtedly had rabies; it was proved in one case; the other two showed every symptom of the disease, and were ordered killed by the chairman of the Board. January 19 a Scotch terrier owned by Mrs. S. B. Samuels of Waltham was killed. He went mad and snapped at Mrs. Samuels' brother, bit her nephew, and snapped at the cat and a neighbor's dog. January 21 the head was sent to the medical school, and small animals which were inoculated showed rabies February 2. The nephew was accordingly sent to New York to undergo the Pasteur preventive treatment, which he took in part.

No bad results have since been reported as a consequence of the bite. January 28 a fox terrier bitch owned in Waltham was killed as rabid. This case was not proved by inoculation experiments, but was in the neighborhood of the others, and was no doubt rabies. Because of so much trouble, January 28 Dr. Wallingford was directed to quarantine every dog in the neighborhood, including the one Mrs. Samuels' dog was said to have bitten, and also to order Mrs. Samuels' cat quarantined. Fourteen dogs and the cat were kept under observation for ninety days. All were released as healthy April 26. This seems to have ended the outbreak in Watertown and Waltham.

Early in February the head of a dog was sent from Chelsea to Dr. Frothingham, with the history that the dog was sick and had bitten a child, and later died, and it was feared he was mad. Inoculation experiments were negative, and the child's parents were written to that they need feel no anxiety, as there was no danger of the child developing rabies. March 28 Dr. L. L. Pierce, inspector of animals in Arlington, reported killing a dog supposed to have rabies, that was bitten by a strange dog about twelve days before; was probably a case, although not proved experimentally. March 30 the head of a dog which acted peculiarly was sent in from Newton; animals inoculated did not develop rabies; the dog was therefore free from this disease. June 3 and July 2 Dr. Thomas Bryant, inspector of animals in Wayland, reported two suspected cases of rabies in dogs; neither, however, were proved by inoculation tests. The latter part of July Dr. Madden of Watertown sent in the head of a dog supposed to have been rabid. He acted so queerly that his owner shot him, thinking he was mad. Inoculations of little animals made by Dr. Frothingham proved negative, and the dog was therefore not rabid. About September 15 a dog owned at Newton Centre acted queerly, and was shot by the police, after biting two other dogs. About October 15 one of the bitten dogs appeared to be sick, and was sent to Dr. Simpson's veterinary hospital, in Malden. Dr. Simpson diagnosed rabies, and sent the head to Dr. Frothingham, who inoculated small animals which developed rabies, proving the correctness of Dr. Simpson's diagnosis. The other

dog was quarantined for ninety days ; December 15 he was still healthy, and was released from quarantine. November 5 a dog owned in West Dennis was killed by his owner on suspicion of having rabies, and the head sent to Dr. Frothingham. The results of the tests are so far negative.

This makes a total of 18 cases of supposed rabies during the year : 4 were proved not to have been rabid, by inoculating rabbits or guinea pigs ; 6 proved to have rabies, as the result of the laboratory tests ; 8 probably had rabies ; and 5 of the 8 certainly were rabid. In addition, 15 dogs and 1 cat were quarantined for ninety days, as a safeguard to prevent any further spread of the disease.

The Board wishes to reiterate what it has said in the past : that is, every case of rabies or suspected rabies should be reported by the police and others to the Cattle Commission, or the local inspector of animals. The inspectors of animals ought at once to report every case which comes to their notice to the commission, and send the head of the suspected dog at once to Dr. Langdon Frothingham, at the Harvard Medical school. If the weather is hot, the head should be sent packed in ice. If the dog in question has bitten anyone it is especially important to send the head in to use for inoculating small animals. If the tests are made at once, it can be decided whether the person bitten ought to undergo the protective inoculation. If the rabbits or guinea pigs develop rabies, the proof that the dog has rabies is certain, and any person bitten should commence the treatment at once. If the experimental animals remain healthy, the person bitten can feel sure that there is no danger of developing rabies. The experimental animals develop rabies soon enough, if the test is made at once, to give the person time to commence the treatment after hearing the result of the test, without having anything to fear from delay. It is said that rabies does not develop in rare instances for months after the bite is inflicted, but usually the symptoms appear in three or four weeks ; therefore, while the Board does not feel that there is absolutely no danger from a bitten dog after ninety days, at the same time, ninety days' quarantine is all dog owners will stand, and there is comparatively little danger after that time.

SWINE DISEASES.

During 1901 twenty-three reports of outbreaks of disease among swine have been received. These diseases are usually grouped under the generic name hog cholera: but, when investigated, the conditions classified under this cognomen are found to be due to various causes. There is true hog cholera, characterized by the ulcerations of the Peyer's patches and solitary glands around the ileo-caecal valve and large intestines, with or without the presence of pneumonia; then there is "swine plague," a form of swine septicæmia, which may be associated with hog cholera, or may exist as an independent disease. In the autumn, when cold weather approaches, pigs kept under barns bury themselves in the warm manure, and when called out to the trough on a frosty morning become chilled, and many in this way develop pneumonia and die. This pneumonia may be a form of the "swine plague," the burying itself in manure predisposing the pig to it. Swine may also have verminous bronchitis, due to the presence of a small, thread-like worm in the bronchial tubes. An outbreak supposed to be swine plague, investigated in Lowell, proved to be this disease.

Of the other twenty-two reports of swine disease brought to the notice of the Board, twelve proved to be hog cholera, including six herds in Gloucester, one in Westfield, two in Haverhill, one in North Grafton, one in Lancaster and one in Townsend. About all that can be done in these cases is to quarantine the swine, forbidding the sale or purchase of any until the outbreak subsides. After the sick have recovered or died, and no new cases are noticed, the owner is advised to disinfect the pens, and the quarantine is raised. Hogs ready for the market in piggeries where hog cholera appears are killed subject to the usual slaughter house inspection, if the owner wishes to market them.

Outbreaks of disease in swine may sometimes be traced to feeding city swill, particularly if it is decomposing or fermenting. All such swill is safer if cooked before using it.

Where room allows, the diseased should be separated from the healthy, and empty pens where sick pigs have been should be thoroughly disinfected before being used again.

The other ten outbreaks reported proved to be cases of swine plague, sporadic pneumonia, or ill condition due to neglect.

This concludes the report of the year's work. Some seasons miscellaneous diseases have been reported, which the Board has investigated because they were supposed to be contagious, but the year 1901 was conspicuous for the absence of any of these occurrences.

Respectfully submitted,

AUSTIN PETERS, *Chairman*,
LEANDER F. HERRICK, *Secretary*,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1901.

FINANCIAL RETURNS OF THE INCORPORATED

| SOCIETIES. | | When incorpo- rated. | Amount originally raised by Contri- bution. (R. L. 124, Sects. 1 and 3.) | Amount now held invested as a Capital Stock. (R. L. 124, Sects. 3 and 12.) | Estimated Market Value of Prop- erty. | Total Assets. |
|------------|---|-------------------------|---|--|---|----------------|
| 1 | Amesbury and Salisbury (Agricultural and Horticultural), | 1881 | \$1,002 32 | ² \$8,179 20 | \$8,179 20 | \$8,179 20 |
| 2 | Barnstable County, | 1844 | 1,740 00 | ³ 8,300 00 | 8,300 00 | 9,386 08 |
| 3 | Berkshire, | 1811 | 3,000 00 | ⁴ 12,497 28 | 12,497 28 | 12,497 28 |
| 4 | Blackstone Valley, | 1884 | 3,000 00 | ⁵ 4,500 00 | 4,500 00 | 4,511 61 |
| 5 | Bristol County, | 1823 | 3,240 00 | ⁵ 32,400 00 | 32,400 00 | 32,400 00 |
| 6 | Deerfield Valley, | 1871 | 4,084 01 | ⁶ 9,200 00 | 9,450 00 | 9,450 00 |
| 7 | Eastern Hampden, | 1856 | 3,000 00 | ⁶ 7,000 00 | 7,000 00 | 7,058 34 |
| 8 | Essex, | 1818 | 4,547 20 | ⁷ 26,386 50 | 26,386 50 | 26,386 50 |
| 9 | Franklin County, | 1850 | 3,768 00 | ⁸ 9,600 00 | 9,600 00 | 9,600 00 |
| 10 | Hampshire, | 1850 | 3,255 26 | ⁵ 4,352 43 | 4,352 43 | 4,456 57 |
| 11 | Hampshire, Franklin and Hampden, | 1818 | 8,141 29 | ⁹ 1,669 90 | 1,669 90 | 1,669 90 |
| 12 | Highland, | 1859 | 3,262 00 | ² 3,202 56 | 3,150 00 | 3,202 56 |
| 13 | Hillside, | 1883 | 3,113 32 | ¹⁰ 5,453 51 | 5,453 51 | 5,837 27 |
| 14 | Hingham (Agricultural and Horticultural), | 1867 | 17,406 15 | ⁵ 22,000 00 | 22,000 00 | 22,011 61 |
| 15 | Hoosac Valley, | 1860 | 2,006 00 | ⁵ 17,300 00 | 17,300 00 | 18,453 82 |
| 16 | Housatonic, | 1848 | 6,335 33 | ¹¹ 24,369 23 | 24,844 23 | 25,095 32 |
| 17 | Manufacturers' Agricultural of North Attleborough, | 1896 | 10,900 00 | ⁵ 10,000 00 | 10,000 00 | 10,270 34 |
| 18 | Marshfield (Agricultural and Horticultural), | 1867 | 3,755 43 | ⁵ 14,050 00 | 14,050 00 | 14,050 00 |
| 19 | Martha's Vineyard, | 1859 | 4,552 17 | ¹² 4,334 17 | 4,334 17 | 4,334 17 |
| 20 | Massachusetts Horticultural, | 1829 | 525 00 | ¹³ 564,524 70 | 840,283 37 | 840,283 37 |
| 21 | Massachusetts Society for Promoting Agriculture, ¹ | 1792 | - | - | - | - |
| 22 | Middlesex North, | 1855 | 3,000 00 | ⁶ 50,000 00 | 50,300 00 | 50,902 40 |
| 23 | Middlesex South, | 1854 | 3,000 00 | ⁶ 12,000 00 | 12,200 00 | 12,216 53 |
| 24 | Nantucket, | 1856 | 3,500 00 | ¹⁴ 3,317 15 | 3,317 15 | 3,317 15 |
| 25 | Oxford, | 1888 | 4,400 00 | ² 8,754 27 | 8,754 27 | 8,754 27 |
| 26 | Plymouth County, | 1819 | 9,550 00 | ⁹ 1,445 18 | 1,445 18 | 1,445 18 |
| 27 | Spencer (Farmers' and Mechanics' Association), | 1888 | 4,034 00 | ⁵ 9,950 00 | 9,950 00 | 10,619 60 |
| 28 | Union (Agricultural and Horticultural), | 1867 | 4,447 23 | ⁵ 9,000 00 | 9,000 00 | 9,322 26 |
| 29 | Weymouth (Agricultural and Horticultural), | 1891 | 10,270 00 | ⁵ 11,270 00 | 11,270 00 | 11,350 67 |
| 30 | Worcester, | 1818 | 7,730 00 | ¹⁰ 88,485 50 | 88,485 50 | 88,538 27 |
| 31 | Worcester East, | 1890 | 2,296 23 | ² 7,704 23 | 7,704 23 | 7,704 23 |
| 32 | Worcester North-west (Agricultural and Mechanical), | 1867 | 3,400 00 | ⁵ 12,600 00 | 12,600 00 | 12,838 56 |
| 33 | Worcester South, | 1855 | 3,127 40 | ⁵ 10,800 00 | 10,800 00 | 10,800 00 |
| 34 | Worcester County West, | 1851 | 3,175 00 | ⁵ 13,600 00 | 13,600 00 | 14,564 38 |
| | | | \$151,673 34 | \$1,028,245 81 | \$1,305,176 92 | \$1,311,507 44 |

1 Made no returns.
2 Invested in real estate, cash, crockery, tables, etc.
3 Invested in real estate and bonds.
4 Invested in real estate, bonds, cash, crockery, tables, etc.
5 Invested in real estate, crockery, tables, etc.
6 Invested in real estate.
7 Invested in real estate, bonds, bank funds, crockery, tables, etc.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1901.

| Real Estate. | Notes. | Stocks and Bonds. | Bank Funds. | Bills Due and Un- paid. | Crockery, Tables, etc. | Cash on Hand. | Total Liabilities. | |
|--------------|------------|-------------------|-------------|----------------------------|---------------------------|---------------|--------------------|----|
| \$7,671 49 | - | - | - | - | \$405 28 | \$102 43 | \$1,500 00 | 1 |
| 7,500 00 | - | \$800 00 | - | - | - | 1,086 08 | 1,950 00 | 2 |
| 12,000 00 | \$296 50 | - | - | - | 200 00 | 78 | 10,017 16 | 3 |
| 4,400 00 | - | - | - | \$7 00 | 100 00 | 4 61 | 1,948 40 | 4 |
| 32,000 00 | - | - | - | - | 400 00 | - | 15,290 90 | 5 |
| 9,200 00 | - | - | - | - | 250 00 | - | 153 10 | 6 |
| 7,000 00 | - | - | - | 57 00 | - | 1 34 | 5,465 18 | 7 |
| 15,300 00 | - | 10,115 00 | - | - | 200 00 | 771 50 | 10,582 95 | 8 |
| 8,500 00 | - | 1,000 00 | - | - | 100 00 | - | 6,594 00 | 9 |
| 4,200 00 | - | - | - | - | 152 43 | 104 14 | 1,313 00 | 10 |
| - | - | - | \$500 00 | - | 1,000 00 | 169 90 | 100 00 | 11 |
| 3,000 00 | - | - | - | - | 150 00 | 52 56 | - | 12 |
| 4,500 00 | - | - | 603 51 | - | 350 00 | 383 76 | - | 13 |
| 20,000 00 | - | - | - | - | 2,000 00 | 11 61 | 300 00 | 14 |
| 16,800 00 | - | - | - | - | 500 00 | 1,153 82 | 10,000 00 | 15 |
| 22,000 00 | - | 1,000 00 | 1,417 57 | 25 00 | 475 00 | 177 75 | 6,225 00 | 16 |
| 9,500 00 | - | - | - | - | 500 00 | 270 34 | - | 17 |
| 13,300 00 | - | - | - | - | 750 00 | - | 3,239 30 | 18 |
| 2,750 00 | 275 00 | - | 1,059 17 | - | 250 00 | - | 129 59 | 19 |
| 515,997 36 | 3,488 75 | 245,338 50 | 21,834 02 | - | 48,977 03 | 4,647 70 | 8,200 00 | 20 |
| - | - | - | - | - | - | - | - | 21 |
| 50,000 00 | - | - | - | - | 300 00 | 602 40 | 16,376 75 | 22 |
| 12,000 00 | - | - | - | - | 200 00 | 16 53 | 8,050 00 | 23 |
| 3,200 00 | - | - | - | - | - | 117 15 | 572 94 | 24 |
| 7,600 00 | - | - | - | - | 200 00 | 954 27 | - | 25 |
| - | - | - | 1,407 19 | - | 37 00 | 99 | - | 26 |
| 9,000 00 | - | - | - | - | 950 00 | 569 60 | 1,669 00 | 27 |
| 8,000 00 | - | - | - | - | 1,000 00 | 322 26 | 1,789 70 | 28 |
| 11,000 00 | - | - | - | - | 270 00 | 80 67 | 1,000 00 | 29 |
| 37,100 00 | - | - | 50,000 00 | 17 00 | 1,385 50 | 35 77 | 3,509 11 | 30 |
| 6,419 93 | - | - | - | - | 560 55 | 723 75 | - | 31 |
| 12,000 00 | - | - | - | - | 600 00 | 238 56 | 4,841 50 | 32 |
| 10,500 00 | - | - | - | - | 300 00 | - | 2,011 25 | 33 |
| 12,600 00 | - | - | 500 00 | - | 1,000 00 | 464 38 | - | 34 |
| \$895,038 78 | \$4,060 25 | \$258,253 50 | \$77,321 46 | \$106 00 | \$63,562 79 | \$13,064 65 | \$122,828 83 | |

8 Invested in real estate, stocks, crockery, tables, etc.
9 Invested in bank funds, cash, crockery, tables, etc.
10 Invested in real estate, bank funds, crockery, tables, etc.
11 Invested in real estate, stocks and bank funds.
12 Invested in real estate, notes, bank funds, crockery, tables, etc.
13 Invested in real estate, library, furniture, bonds and other securities.
14 Invested in real estate and cash.

FINANCIAL RETURNS OF THE INCORPORATED

| SOCIETIES. | | Premiums Due and Unpaid. | Outstanding Bills. | Mortgages or Like Liabilities. | Total Receipts. | Bounty. | Income from Notes and Bank Funds. |
|------------|---|--------------------------|--------------------|--------------------------------|-----------------|-------------|-----------------------------------|
| 1 | Amesbury and Salisbury (Agricultural and Horticultural), | - | - | \$1,700 00 | \$3,881 10 | \$600 00 | - |
| 2 | Barnstable County, | - | - | 1,950 00 | 4,919 98 | 600 00 | - |
| 3 | Berkshire, | \$923 25 | \$2,093 91 | 1,000 00 | 5,355 92 | 600 00 | \$1,755 90 |
| 4 | Blackstone Valley, | - | 58 40 | 1,800 00 | 1,919 13 | 570 00 | - |
| 5 | Bristol County, | 82 75 | 208 15 | 15,000 00 | 23,284 93 | 600 00 | - |
| 6 | Deerfield Valley, | - | 153 10 | - | 1,989 45 | 600 00 | - |
| 7 | Eastern Hampden, | - | 555 18 | 4,910 00 | 2,170 75 | 600 00 | - |
| 8 | Essex, | - | - | 10,582 95 | 2,056 20 | 600 00 | - |
| 9 | Franklin County, | 305 00 | 2,500 00 | 3,789 00 | 6,868 41 | 600 00 | 377 02 |
| 10 | Hampshire, | - | - | 1,313 00 | 2,034 98 | 600 00 | - |
| 11 | Hampshire, Franklin and Hampden, | - | 2 100 00 | - | 3,174 22 | 335 00 | 31 92 |
| 12 | Highland, | - | - | - | 1,739 99 | 600 00 | - |
| 13 | Hillside, | - | - | - | 1,610 89 | 600 00 | 22 36 |
| 14 | Hingham (Agricultural and Horticultural), | - | - | 300 00 | 1,962 40 | 600 00 | 300 00 |
| 15 | Hoosac Valley, | - | - | 10,000 00 | 5,030 78 | 600 00 | - |
| 16 | Housatonic, | 3 25 00 | - | 6,200 00 | 11,606 06 | 600 00 | 48 34 |
| 17 | Manufacturers' Agricultural of North Attleborough, | - | - | - | 1,984 95 | 470 50 | - |
| 18 | Marshfield (Agricultural and Horticultural), | 29 30 | - | 3,210 00 | 3,782 71 | 600 00 | - |
| 19 | Martha's Vineyard, | 5 00 | 124 59 | - | 1,003 17 | 600 00 | 59 50 |
| 20 | Massachusetts Horticultural, | 8,200 00 | - | - | 183,900 49 | 600 00 | 720 80 |
| 21 | Massachusetts Society for Promoting Agriculture, ¹ | - | - | - | - | - | - |
| 22 | Middlesex North, | 76 75 | - | 16,300 00 | 4,711 63 | 600 00 | - |
| 23 | Middlesex South, | - | 50 00 | 8,000 00 | 1,240 10 | 600 00 | - |
| 24 | Nantucket, | - | 572 94 | - | 1,166 99 | 600 00 | - |
| 25 | Oxford, | - | - | - | 4,109 08 | 600 00 | - |
| 26 | Plymouth County, | - | - | - | 316 55 | 291 68 | - |
| 27 | Spencer (Farmers' and Mechanics' Association), | - | 769 00 | 900 00 | 4,436 00 | 600 00 | - |
| 28 | Union (Agricultural and Horticultural), | - | 139 70 | 1,650 00 | 2,391 20 | 600 00 | - |
| 29 | Weymouth (Agricultural and Industrial), | - | - | 1,000 00 | 4,820 02 | 600 00 | - |
| 30 | Worcester, | - | 375 56 | 3,133 55 | 4,210 72 | 600 00 | 1,978 32 |
| 31 | Worcester East, | - | - | - | 11,820 00 | 600 00 | 3 20 |
| 32 | Worcester North-west (Agricultural and Mechanical), | 41 50 | - | 4,800 00 | 7,455 33 | 600 00 | - |
| 33 | Worcester South, | 11 25 | - | 2,000 00 | 3,422 26 | 600 00 | - |
| 34 | Worcester County West, | - | - | - | 3,197 31 | 600 00 | - |
| | | \$9,699 80 | \$7,700 53 | \$105,628 50 | \$324,174 20 | \$19,067 18 | \$5,297 36 |

¹ Made no returns.

² About.

³ Estimated.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1901—Concluded.

| Income from Stocks and Bonds. | Received from New Members. | Received as Dona- tions. | Received from all Other Sources. | Total Expendi- tures. | Premiums and Gratuities Paid. | Current Running Expenses. | Interest. | All Other Ex- penses. | |
|----------------------------------|-------------------------------|-----------------------------|-------------------------------------|--------------------------|----------------------------------|------------------------------|------------|--------------------------|----|
| \$20 00 | \$6 00 | \$1 00 | \$3,274 10 | \$3,778 67 | \$676 70 | \$200 00 | \$106 50 | \$2,795 47 | 1 |
| - | 45 00 | 279 00 | 3,975 98 | 3,833 90 | 2,008 50 | 1,720 90 | 104 50 | - | 2 |
| - | 20 00 | - | 3,580 02 | 5,955 14 | 909 50 | 786 07 | 353 50 | 3,906 07 | 3 |
| - | 14 00 | 41 00 | 1,254 13 | 1,914 52 | 603 00 | 1,187 55 | 123 97 | - | 4 |
| - | 60 00 | 22 00 | 22,602 93 | 23,202 18 | 5,618 20 | 9,832 82 | 951 16 | 6,800 00 | 5 |
| - | 60 00 | 9 20 | 1,320 25 | 1,969 57 | 1,089 90 | 729 67 | 12 00 | 138 00 | 6 |
| - | 5 00 | 105 35 | 1,346 40 | 2,525 28 | 702 70 | 455 00 | 173 00 | 1,195 58 | 7 |
| 646 33 | 27 00 | - | 897 42 | 2,826 92 | 1,347 40 | 698 81 | 495 62 | 285 09 | 8 |
| - | - | - | 5,851 39 | 6,874 41 | 1,481 70 | - | 188 66 | 5,204 05 | 9 |
| - | 22 50 | 59 48 | 1,353 00 | 1,930 84 | 624 78 | 676 68 | 79 38 | 550 00 | 10 |
| - | - | - | - | - | - | - | - | - | - |
| - | 108 00 | 40 50 | 2,658 80 | 3,179 17 | 958 00 | 2,119 40 | - | 101 77 | 11 |
| - | 22 00 | - | 1,117 99 | 1,687 43 | 701 30 | 960 97 | 4 20 | 20 96 | 12 |
| - | 105 00 | 19 85 | 863 68 | 1,657 63 | 876 15 | 781 48 | - | - | 13 |
| - | - | - | - | - | - | - | - | - | - |
| - | 5 00 | 46 40 | 1,011 00 | 1,797 36 | 643 90 | 713 69 | 12 88 | 426 89 | 14 |
| - | 40 00 | - | 4,390 78 | 4,885 98 | 925 00 | 3,556 13 | 404 85 | - | 15 |
| 50 00 | 248 67 | - | 10,659 05 | 10,428 33 | 2,037 50 | 7,691 22 | 348 22 | 351 39 | 16 |
| - | - | - | - | - | - | - | - | - | - |
| - | - | - | 1,514 45 | 2,057 95 | 575 00 | 1,460 52 | - | 22 43 | 17 |
| - | - | - | - | - | - | - | - | - | - |
| - | 5 00 | 285 00 | 2,892 71 | 3,121 20 | 1,247 55 | 1,035 54 | 208 94 | 629 17 | 18 |
| - | 40 00 | 2 00 | 301 67 | 1,103 52 | 708 91 | 297 09 | - | 97 52 | 19 |
| 10,195 00 | 1,246 00 | 28,393 77 | 149,808 39 | 232,283 50 | 47,661 70 | 26,708 52 | - | 197,913 28 | 20 |
| - | - | - | - | - | - | - | - | - | - |
| - | 16 00 | - | 4,095 63 | 5,369 18 | 816 75 | 1,981 19 | 750 00 | 1,821 24 | 21 |
| - | 17 50 | 65 55 | 557 05 | 1,229 54 | 722 35 | 437 61 | 69 58 | - | 22 |
| - | 27 00 | 105 00 | 434 99 | 1,049 84 | 612 00 | 437 84 | - | - | 23 |
| - | 18 00 | 60 25 | 3,430 83 | 3,154 81 | 1,432 84 | 445 71 | - | 1,276 26 | 24 |
| - | 24 87 | - | - | 365 55 | 285 00 | 80 55 | - | - | 25 |
| - | - | - | - | - | - | - | - | - | 26 |
| - | 18 00 | 700 00 | 3,118 00 | 5,732 54 | 2,024 84 | 806 15 | 35 00 | 2,866 55 | 27 |
| - | 24 00 | - | 1,767 20 | 2,068 94 | 1,199 19 | 787 25 | 82 50 | - | 28 |
| - | - | - | - | - | - | - | - | - | - |
| - | - | - | 4,220 02 | 4,820 02 | 608 81 | 150 00 | 75 00 | 3,986 21 | 29 |
| - | - | - | 1,632 40 | 4,174 95 | 600 00 | 627 61 | 1,978 32 | 969 02 | 30 |
| - | 55 00 | 612 00 | 10,553 80 | 10,645 72 | 1,204 25 | 9,441 47 | - | - | 31 |
| - | - | - | - | - | - | - | - | - | - |
| - | 12 50 | - | 6,842 83 | 7,216 77 | 2,812 00 | 4,127 21 | 277 56 | - | 32 |
| - | 21 00 | 28 00 | 2,773 26 | 3,545 12 | 1,849 20 | 1,195 84 | 105 00 | 395 08 | 33 |
| - | 65 00 | 53 32 | 2,478 99 | 2,922 82 | 1,692 73 | 1,230 09 | - | - | 34 |
| \$10,911 33 | \$2,378 04 | \$30,868 67 | \$262,573 14 | \$369,309 30 | \$47,257 35 | \$83,360 58 | \$6,940 34 | \$231,752 03 | |

* Awarded in 1900.

* And assessments.

* And principal.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

| SOCIETIES. | | Total Amount offered in Premiums. | Total Amount awarded in Premiums and Gratuities. | Total Amount paid in Premiums and Gra- tuities. | Amount offered under Head of Farms, etc. | Amount awarded under Head of Farms, etc. | Amount paid under Head of Farms, etc | Amount offered under Head of Farm and Pet Stock. |
|------------|--|--------------------------------------|--|---|---|--|---|--|
| 1 | Amesbury and Salisbury (Agricultural and Horti- cultural), | \$1,500 00 | \$703 25 | \$676 70 | - | - | - | \$800 00 |
| 2 | Barnstable County, | 2,447 50 | 2,008 50 | 2,008 50 | \$123 00 | - | - | 635 50 |
| 3 | Berkshire, | 1,488 50 | 923 25 | 909 50 | - | - | - | 1,053 50 |
| 4 | Blackstone Valley, | 900 00 | 603 00 | 603 00 | 45 00 | \$45 00 | \$45 00 | 398 00 |
| 5 | Bristol County, | 8,288 25 | 5,700 95 | 5,618 20 | 190 00 | 57 00 | 32 00 | 2,216 00 |
| 6 | Deerfield Valley, | 1,318 25 | 1,099 10 | 1,089 90 | - | - | - | 781 00 |
| 7 | Eastern Hampden, | 711 50 | 702 70 | 702 70 | 98 00 | 7 00 | 7 00 | 2 - |
| 8 | Essex, | 2,653 00 | 1,506 80 | ³ 1,347 40 | 119 00 | - | ³ 24 00 | 1,350 00 |
| 9 | Franklin County, | 1,838 50 | 1,786 70 | 1,481 70 | - | - | - | 1,500 00 |
| 10 | Hampshire, | 838 00 | 624 78 | 624 78 | 25 00 | - | - | 489 00 |
| 11 | Hampshire, Franklin and Hampden, | 1,362 25 | 1,080 25 | 958 00 | 50 00 | - | - | 935 00 |
| 12 | Highland, | 749 65 | 701 30 | 701 30 | - | - | - | 435 50 |
| 13 | Hillside, | 892 00 | 876 15 | 876 15 | 4 00 | 4 00 | 4 00 | 600 00 |
| 14 | Hingham (Agricultural and Horticultural), | 1,534 85 | 643 90 | 643 90 | 186 75 | 4 00 | 4 00 | - |
| 15 | Hoosac Valley, | 1,762 75 | 925 00 | 925 00 | - | - | - | 1,157 50 |
| 16 | Housatonic, | 2,766 75 | 2,037 50 | 2,037 50 | - | - | - | 1,700 00 |
| 17 | Manufacturers' Agricultural of North Attleborough, . . . | 991 15 | 575 00 | 575 00 | - | - | - | 637 00 |
| 18 | Marshfield (Agricultural and Horticultural), | 1,933 25 | 1,318 30 | 1,247 55 | 110 00 | - | - | 465 50 |
| 19 | Martha's Vineyard, | 792 75 | 729 71 | 708 91 | 30 00 | 10 50 | 10 50 | 437 50 |
| 20 | Massachusetts Horticultural, Massachusetts Society for Promoting Agriculture, ¹ . . | 9,957 50 | 4,063 25 | ³ 7,661 70 | 677 00 | 480 00 | ³ 478 80 | - |
| 22 | Middlesex North, | 1,323 50 | 866 25 | 816 75 | - | - | - | 609 00 |
| 23 | Middlesex South, | 1,622 55 | 722 35 | 722 35 | 81 00 | 6 00 | 6 00 | 827 00 |
| 24 | Nantucket, | 1,376 75 | 612 00 | 612 00 | 96 00 | 12 00 | 12 00 | 690 00 |
| 25 | Oxford, | 1,844 25 | 1,484 00 | 1,432 84 | 78 00 | 47 50 | 47 50 | 874 00 |
| 26 | Plymouth County, | 390 00 | 285 00 | 285 00 | 105 00 | - | - | 125 00 |
| 27 | Spencer (Farmers' and Me- chanics' Association), . . . | 2,024 84 | 2,024 84 | 2,024 84 | 27 00 | 27 00 | 27 00 | 740 50 |
| 28 | Union (Agricultural and Horticultural), | 1,846 75 | 1,222 88 | 1,199 19 | 10 00 | 5 00 | 5 00 | 783 00 |
| 29 | Weymouth (Agricultural and Industrial), | 1,140 60 | 616 36 | 608 81 | - | - | - | 679 00 |
| 30 | Worcester, | 608 00 | 600 00 | 600 00 | - | - | - | 250 00 |
| 31 | Worcester East, | 1,643 75 | 1,204 25 | 1,204 25 | 26 00 | 26 00 | 26 00 | 1,058 00 |
| 32 | Worcester North-west (Agri- cultural and Mechanical), . | 3,211 00 | 2,916 10 | 2,812 00 | 30 00 | 19 00 | 19 00 | 1,256 00 |
| 33 | Worcester South, | 2,450 00 | 1,867 05 | 1,849 20 | 113 00 | 40 00 | 40 00 | 1,004 50 |
| 34 | Worcester County West, . . | 1,963 50 | 1,745 05 | 1,692 73 | 66 00 | 33 00 | 33 00 | 859 50 |
| | | \$66,171 89 | \$44,775 52 | \$47,257 35 | \$2,319 75 | \$823 00 | \$813 80 | \$25,346 50 |

¹ Held no fair and made no returns. ² Made no return. ³ Awarded in 1900, paid in 1901.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1901.

| Amount awarded under Head of Farm and Pet Stock. | Amount paid under Head of Farm and Pet Stock. | Amount offered under Head of Field and Garden Crops. | Amount awarded under Head of Field and Garden Crops. | Amount paid under Head of Field and Garden Crops. | Amount offered under Head of Farm and Garden Products. | Amount awarded under Head of Farm and Garden Products. | Amount paid under Head of Farm and Garden Products. | Amount offered under Head of Dairy Products. | Amount awarded under Head of Dairy Products. | |
|--|---|--|--|---|--|--|---|--|--|----|
| \$294 50 | \$292 50 | \$200 00 | \$10 00 | - | \$250 00 | \$176 80 | \$163 85 | \$3 25 | \$2 50 | 1 |
| 413 50 | 413 50 | 149 00 | 41 50 | \$41 50 | 254 00 | 231 55 | 231 55 | 10 00 | 8 00 | 2 |
| 598 00 | 598 00 | - | - | - | 202 75 | 92 25 | 92 25 | 40 00 | 24 00 | 3 |
| 372 00 | 372 00 | 54 75 | 40 00 | 40 00 | 95 50 | 71 75 | 71 75 | 5 50 | - | 4 |
| 1,471 50 | 1,460 00 | 150 00 | 45 00 | 32 20 | 394 75 | 341 75 | 332 25 | 49 50 | 28 50 | 5 |
| 560 50 | 554 50 | - | - | - | 99 50 | 77 80 | 77 55 | 18 00 | 6 00 | 6 |
| 470 50 | 470 50 | 18 75 | 16 25 | 16 25 | 4 - | 37 00 | 37 00 | 18 00 | - | 7 |
| 916 00 | 5 677 50 | 272 00 | 59 00 | 5 29 00 | 500 00 | 430 00 | 5 440 75 | - | - | 8 |
| 1,469 00 | 1,164 00 | - | - | - | 175 00 | 161 20 | 161 20 | 22 00 | 10 00 | 9 |
| 379 50 | 379 50 | 44 00 | - | - | 156 00 | 141 50 | 141 50 | 13 00 | 2 00 | 10 |
| 769 25 | 704 50 | 65 00 | 22 00 | 22 00 | 209 25 | 171 50 | 150 75 | 36 00 | 14 00 | 11 |
| 429 50 | 429 50 | 35 00 | 25 50 | 25 50 | 60 59 | 48 35 | 48 35 | 7 50 | 7 00 | 12 |
| 558 75 | 558 75 | 50 00 | 58 75 | 58 75 | 83 00 | 72 95 | 72 95 | 11 00 | 7 00 | 13 |
| - | - | 91 00 | - | - | 987 85 | 506 15 | 506 15 | 6 00 | 3 00 | 14 |
| 499 75 | 499 75 | - | - | - | 177 75 | 122 25 | 122 25 | 44 00 | 20 00 | 15 |
| 1,034 25 | 1,034 25 | 253 00 | 245 00 | 245 00 | 359 00 | 312 00 | 312 00 | 42 00 | 41 00 | 16 |
| 351 55 | 351 55 | - | - | - | 177 40 | 125 90 | 125 90 | 3 75 | 1 75 | 17 |
| 272 75 | 263 25 | 95 50 | - | - | 313 00 | 164 25 | 129 85 | 12 50 | 6 00 | 18 |
| 274 25 | 274 25 | 160 00 | 30 00 | 30 00 | 104 01 | 199 99 | 199 99 | 13 00 | 11 75 | 19 |
| - | - | - | - | - | 9,280 50 | 3,583 25 | 5 7,182 90 | - | - | 20 |
| - | - | - | - | - | - | - | - | - | - | 21 |
| 455 00 | 425 00 | - | - | - | 504 00 | 269 75 | 250 25 | 4 50 | - | 22 |
| 170 75 | 170 75 | 42 00 | - | - | 180 20 | 89 80 | 89 80 | 6 00 | 5 00 | 23 |
| 311 50 | 311 50 | 174 00 | 28 25 | 28 25 | 137 00 | 28 25 | 28 25 | 16 00 | 5 50 | 24 |
| 621 00 | 598 75 | 34 25 | 24 75 | 20 67 | 83 50 | 37 00 | 30 66 | 12 00 | 9 00 | 25 |
| 125 00 | 125 00 | - | - | - | 70 00 | 70 00 | 70 00 | - | - | 26 |
| 740 50 | 740 50 | 62 75 | 62 75 | 62 75 | 136 75 | 136 75 | 136 75 | 188 00 | 133 00 | 27 |
| 433 00 | 423 13 | 95 50 | 46 00 | 46 00 | 52 25 | 39 95 | 39 40 | 13 25 | 9 75 | 28 |
| 263 60 | 262 55 | 46 00 | - | - | 174 95 | 172 30 | 167 55 | 5 50 | 1 00 | 29 |
| 230 00 | 230 00 | 293 50 | 314 50 | 314 50 | 64 50 | 55 50 | 55 50 | - | - | 30 |
| 792 00 | 792 00 | - | - | - | 254 00 | 200 00 | 200 00 | 21 00 | 6 00 | 31 |
| 1,003 75 | 926 75 | - | - | - | 149 00 | 144 45 | 131 50 | 25 00 | 9 00 | 32 |
| 645 50 | 598 50 | - | - | - | 203 25 | 140 50 | 140 50 | 16 00 | 13 00 | 33 |
| 731 00 | 704 50 | - | - | - | 109 00 | 72 25 | 69 82 | 15 00 | 9 00 | 34 |
| \$17,187 15 | \$16,336 23 | \$2,386 00 | \$1,069 25 | \$1,012 37 | \$15,998 16 | \$2,524 69 | \$12,010 72 | \$677 25 | \$392 75 | |

4 Made no return.

5 Awarded in 1900, paid in 1901.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

| SOCIETIES. | | Amount paid under Head of Dairy Products. | Amount offered under Head of Domestic Manufactures. | Amount awarded under Head of Domestic Manufactures. | Amount paid under Head of Domestic Manufactures. | Amount awarded under Head of Miscellaneous. | Amount paid under Head of Miscellaneous. |
|------------|---|---|---|---|--|---|--|
| 1 | Amesbury and Salisbury (Agricultural and Horticultural), . . | \$2 50 | \$110 00 | \$107 85 | \$106 85 | \$111 60 | \$111 00 |
| 2 | Barnstable County, | 2 00 | 208 00 | 245 95 | 245 95 | 268 00 | 268 00 |
| 3 | Berkshire, | 24 00 | 94 95 | 72 75 | 72 75 | - | - |
| 4 | Blackstone Valley, | - | 26 50 | 22 00 | 22 00 | 41 60 | 41 60 |
| 5 | Bristol County, | 22 50 | 325 00 | 222 45 | 270 25 | 171 75 | 170 00 |
| 6 | Deerfield Valley, | 6 00 | 104 50 | 86 45 | 83 50 | 74 05 | 74 05 |
| 7 | Eastern Hampden, | - | 76 75 | 56 55 | 56 55 | - | - |
| 8 | Essex, | - | 204 00 | 121 50 | ² 136 70 | 188 00 | ² 175 50 |
| 9 | Franklin County, | 10 00 | 141 50 | 127 20 | 127 20 | - | - |
| 10 | Hampshire, | 2 00 | 69 00 | 57 53 | 57 53 | 44 25 | 44 25 |
| 11 | Hampshire, Franklin and Hampden, | 14 00 | 67 00 | 64 50 | 41 75 | 39 00 | 25 00 |
| 12 | Highland, | 7 00 | 82 80 | 85 05 | 85 05 | 25 90 | 25 90 |
| 13 | Hillside, | 7 00 | 80 00 | 87 05 | 87 05 | 12 00 | 12 00 |
| 14 | Hingham (Agricultural and Horticultural), | 3 00 | 137 25 | 91 30 | 91 30 | 39 45 | 39 45 |
| 15 | Housac Valley, | 20 00 | 282 50 | 249 75 | 249 75 | 121 00 | 121 00 |
| 16 | Housatonic, | 41 00 | 339 00 | 319 50 | 319 50 | 898 60 | 898 60 |
| 17 | Manufacturers' Agricultural of North Attleborough, | 1 75 | 139 50 | 68 30 | 68 30 | 27 50 | 27 50 |
| 18 | Marshfield (Agricultural and Horticultural), | 6 00 | 254 00 | 197 55 | 193 90 | 25 25 | 24 75 |
| 19 | Martha's Vineyard, | 11 75 | 85 00 | 153 13 | 153 13 | 60 50 | 60 50 |
| 20 | Massachusetts Horticultural, | - | - | - | - | - | - |
| 21 | Massachusetts Society for Promoting Agriculture, ¹ | - | - | - | - | - | - |
| 22 | Middlesex North, | - | 147 50 | 83 00 | 83 00 | 58 50 | 58 50 |
| 23 | Middlesex South, | 5 00 | 83 25 | 48 30 | 48 30 | 2 50 | 2 50 |
| 24 | Nantucket, | 5 50 | 128 00 | 90 75 | 90 75 | 45 75 | 45 75 |
| 25 | Oxford, | 6 25 | 74 50 | 56 75 | 44 76 | 13 00 | 9 25 |
| 26 | Plymouth County, | - | 65 00 | 65 00 | 65 00 | 25 00 | 25 00 |
| 27 | Spencer (Farmers' and Mechanics' Association), | 133 00 | 52 50 | 52 50 | 52 50 | 132 00 | 132 00 |
| 28 | Union (Agricultural and Horticultural), | 9 75 | 110 15 | 86 38 | 75 99 | 122 80 | 122 80 |
| 29 | Weymouth (Agricultural and Industrial), | 1 00 | 165 15 | 144 26 | 142 41 | 35 20 | 35 20 |
| 30 | Worcester, | - | - | - | - | - | - |
| 31 | Worcester East, | 6 00 | 197 50 | 88 00 | 88 00 | 87 25 | 87 25 |
| 32 | Worcester North-west (Agricultural and Mechanical), | 9 00 | 62 00 | 49 90 | 36 75 | 39 00 | 39 00 |
| 33 | Worcester South, | 13 00 | 67 50 | 64 30 | 61 30 | 18 75 | 18 75 |
| 34 | Worcester County West, | 9 00 | 68 00 | 54 80 | 53 35 | 46 00 | 23 06 |
| | | \$390 00 | \$4,114 30 | \$3,380 30 | \$3,314 12 | \$2,774 20 | \$2,718 16 |

¹ Held no fair and made no returns.² Awarded in 1900, paid in 1901.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1901—Concluded

| Amount paid for Trotting. | Number of Persons receiving Premiums. | Number of Persons receiving Gratuities. | Number of Cities and Towns where Premiums were Paid. | Amount paid to Parties Outside the State. | Number of Male Members. | Number of Female Members. | Total Membership. | Number of Institutes Held. | Average Number attending Institutes. | |
|---------------------------|---------------------------------------|---|--|---|-------------------------|---------------------------|-------------------|----------------------------|--------------------------------------|----|
| - | 3 - | - | 14 | \$105 00 | 212 | 28 | 240 | 4 | 68 | 1 |
| \$800 00 | 137 | 254 | 12 | - | 282 | 222 | 510 | 3 | 67 | 2 |
| 3 - | 3 - | 3 - | 3 - | 3 - | 625 | 75 | 700 | 3 | 32 | 3 |
| - | 82 | - | 12 | 50 | 225 | 200 | 425 | 3 | 35 | 4 |
| 3,303 00 | 590 | 70 | 48 | 334 25 | 655 | 180 | 835 | 3 | 93 | 5 |
| 280 00 | 250 | - | 21 | 4 00 | 882 | 248 | 1,130 | 4 | 116 | 6 |
| 410 00 | 115 | - | 21 | 1 50 | 282 | 195 | 483 | 3 | 72 | 7 |
| - | 396 | - | 27 | - | 1,208 | 12 | 1,220 | 4 | 93 | 8 |
| 1,200 00 | 400 | - | 3 - | - | 1,000 | 200 | 1,500 | 3 | 43 | 9 |
| 550 00 | 3 - | 3 - | 12 | - | 525 | 198 | 723 | 3 | 123 | 10 |
| 520 00 | 276 | 70 | 25 | - | 720 | 270 | 990 | 3 | 117 | 11 |
| 80 00 | 143 | 4 | 19 | - | 264 | 120 | 384 | 3 | 62 | 12 |
| 55 00 | 454 | 3 | 25 | - | 773 | 38 | 811 | 4 | 104 | 13 |
| - | 65 | 55 | 22 | 15 | 434 | 180 | 614 | 6 | 58 | 14 |
| 1,500 00 | 203 | - | 13 | 89 35 | 954 | 15 | 969 | 3 | 19 | 15 |
| 1,640 00 | 384 | - | 20 | 2 00 | 1,514 | 54 | 1,568 | 3 | 37 | 16 |
| 300 00 | 138 | 84 | 8 | - | 55 | 51 | 106 | 4 | 181 | 17 |
| 652 50 | 78 | 270 | 34 | 3 00 | 568 | 307 | 875 | 3 | 83 | 18 |
| - | 140 | 52 | 5 | - | 108 | 86 | 194 | 3 | 49 | 19 |
| - | 231 | 130 | 85 | 289 00 | 772 | 98 | 870 | 10 | 205 | 20 |
| - | - | - | - | - | - | - | - | - | - | 21 |
| - | 217 | 72 | 15 | - | 908 | 124 | 1,032 | 4 | 188 | 22 |
| 400 00 | 66 | 5 | 6 | - | 364 | 215 | 579 | 3 | 81 | 23 |
| 90 00 | 95 | 75 | 1 | - | 240 | 374 | 614 | 3 | 12 | 24 |
| 675 00 | 119 | 3 | 18 | - | 340 | 280 | 620 | 3 | 208 | 25 |
| - | 3 - | - | - | - | 780 | 590 | 1,370 | 4 | 85 | 26 |
| 805 00 | 156 | - | 20 | 60 00 | 470 | 403 | 873 | 3 | 44 | 27 |
| 480 00 | 161 | 58 | 24 | 8 38 | 632 | 735 | 1,367 | 3 | 252 | 28 |
| - | 390 | 275 | 21 | - | 480 | 10 | 490 | 3 | 50 | 29 |
| - | 76 | 10 | 17 | - | 1,650 | 162 | 1,812 | 3 | 233 | 30 |
| 946 50 | 222 | 62 | 21 | 3 00 | 442 | 266 | 708 | 3 | 148 | 31 |
| 1,650 00 | 153 | - | 25 | 61 00 | 678 | 384 | 1,062 | 3 | 148 | 32 |
| 945 00 | 92 | 45 | 26 | 112 50 | 751 | 777 | 1,528 | 3 | 81 | 33 |
| 800 00 | 190 | 25 | 33 | 373 00 | 423 | 65 | 488 | 3 | 75 | 34 |
| \$18,082 00 | 6,019 | 1,630 | 650 | \$1,446 53 | 20,828 | 7,162 | 27,990 | 116 | 5 104+ | |

* Made no return.

+ Estimated.

5 General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN
MASSACHUSETTS.

MARCH, 1902.

STATE BOARD OF AGRICULTURE, 1902.

Members ex Officio.

HIS EXCELLENCY W. MURRAY CRANE.

HIS HONOR JOHN L. BATES.

HON. WM. M. OLIN, *Secretary of the Commonwealth.*

H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*

C. A. GOESSMANN, PH.D., LL.D., *Chemist.*

AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*

JAMES W. STOCKWELL, *Secretary.*

Members appointed by the Governor and Council.

| | Term Expires |
|---|--------------|
| FRANCIS H. APPLETON of Peabody, | 1903 |
| WARREN C. JEWETT of Worcester, | 1904 |
| WILLIAM R. SESSIONS of Springfield, | 1905 |

Members chosen by the Incorporated Societies.

| | | |
|---|--|------|
| <i>Amesbury and Salisbury (Agr'l and Hort'l),</i> | F. W. SARGENT of Amesbury, | 1903 |
| <i>Barnstable County,</i> | JOHN BURSLEY of West Barnstable, | 1904 |
| <i>Berkshire,</i> | WESLEY B. BARTON of Dalton, | 1903 |
| <i>Blackstone Valley,</i> | SAMUEL B. TAFT of Uxbridge, | 1903 |
| <i>Bristol County (delegate-elect),</i> | WILLIAM A. LANE of Norton, | 1905 |
| <i>Deerfield Valley,</i> | ARTHUR A. SMITH of Colrain, | 1905 |
| <i>Eastern Hampden,</i> | O. E. BRADWAY of Monson, | 1903 |
| <i>Essex,</i> | { JOHN M. DANFORTH of Lynnfield (P.O. Lynnfield Centre), | 1905 |
| <i>Franklin County,</i> | JOHN S. ANDERSON of Shelburne, | 1904 |
| <i>Hampshire,</i> | A. M. LYMAN of Montague, | 1904 |
| <i>Hampshire, Franklin and Hampden,</i> | H. C. COMINS of Northampton, | 1903 |
| <i>Highland,</i> | C. K. BREWSTER of Worthington, | 1905 |
| <i>Hillside,</i> | J. W. GURNEY of Cummington, | 1905 |
| <i>Hingham (Agr'l and Hort'l),</i> | EDMUND HERSEY of Hingham, | 1903 |
| <i>Hoosac Valley,</i> | { GEO. P. CARPENTER of Williamstown (P. O. Blackinton), | 1903 |
| <i>Housatonic,</i> | CHARLES B. BENEDICT of Egremont, | 1903 |
| <i>Man't'rs' Agr'l (No. Attleborough),</i> | OSCAR S. THAYER of Attleborough, | 1903 |
| <i>Marshfield (Agr'l and Hort'l),</i> | HENRY A. TURNER of Norwell, | 1903 |
| <i>Martha's Vineyard,</i> | JOHNSON WHITING of West Tisbury, | 1904 |
| <i>Massachusetts Horticultural,</i> | WM. H. SPOONER of Jamaica Plain, | 1903 |
| <i>Massachusetts Society for Promoting Agriculture,</i> | N. I. BOWDITCH of Frammingham, | 1903 |
| <i>Middlesex North,</i> | { JOSHUA CLARK of Tewksbury (P. O. Lowell), | 1904 |
| <i>Middlesex South,</i> | { ISAAC DAMON of Wayland (P. O. Cohituate), | 1905 |
| <i>Nantucket,</i> | J. S. APPLETON of Nantucket, | 1903 |
| <i>Oxford,</i> | W. M. WELLINGTON of Oxford, | 1904 |
| <i>Plymouth County,</i> | { AUGUSTUS PRATT of North Middleborough, | 1905 |
| <i>Spencer (Far's and Mech's Assoc'n),</i> | JOHN G. AVERY of Spencer, | 1904 |
| <i>Union (Agr'l and Hort'l),</i> | ENOS W. BOISE of Blandford, | 1904 |
| <i>Weymouth (Agr'l and Ind'l),</i> | QUINCY L. REED of South Weymouth, | 1903 |
| <i>Worcester,</i> | J. LEWIS ELLSWORTH of Worcester, | 1905 |
| <i>Worcester East,</i> | W. A. KILBOURN of South Lancaster, | 1903 |
| <i>Worcester North-west (Agr'l and Mech'l),</i> | { T. H. GOODSPEED of Athol (P. O. Athol Centre), | 1904 |
| <i>Worcester South,</i> | C. D. RICHARDSON of West Brookfield, | 1904 |
| <i>Worcester County West,</i> | J. HARDING ALLEN of Barre, | 1905 |

ORGANIZATION OF THE BOARD.

OFFICERS.

| | |
|----------------------------|---|
| <i>President,</i> | HIS EXCELLENCY W. MURRAY CRANE, <i>ex Officio</i> . |
| <i>1st Vice-President,</i> | WILLIAM R. SESSIONS of Springfield. |
| <i>2d Vice-President,</i> | AUGUSTUS PRATT of North Middleborough. |
| <i>Secretary,</i> | JAMES W. STOCKWELL of Sutton. |

Office, Rooms 136-138, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. KILBOURN of South Lancaster.
 ISAAC DAMON of Wayland.
 JOHN BURSLEY of West Barnstable.
 WM. H. SPOONER of Boston.
 FRANCIS H. APPLETON of Peabody.
 AUGUSTUS PRATT of North Middleborough.
 F. W. SARGENT of Amesbury.
 J. L. ELLSWORTH of Worcester.

Committee on Agricultural Societies.

Messrs. W. A. KILBOURN of South Lancaster.
 Q. L. REED of South Weymouth.
 GEO. P. CARPENTER of Williamstown.
 O. E. BRADWAY of Monson.
 J. HARDING ALLEN of Barre.

Committee on Domestic Animals and Sanitation.

Messrs. ISAAC DAMON of Wayland.
 OSCAR S. THAYER of Attleborough.
 JOSHUA CLARK of Tewksbury.
 JOHNSON WHITING of West Tisbury.
 JOHN S. ANDERSON of Shelburne.

Committee on Gypsy Moth, Insects and Birds.

Messrs. AUGUSTUS PRATT of North Middleborough.
 F. W. SARGENT of Amesbury.
 J. M. DANFORTH of Lynnfield Centre.
 JOHN G. AVERY of Spencer.
 WM. R. SESSIONS of Springfield.

Committee on Dairy Bureau and Agricultural Products.

Messrs. J. L. ELLSWORTH of Worcester.
 C. D. RICHARDSON of West Brookfield.
 F. W. SARGENT of Amesbury.
 C. B. BENEDICT of Egremont.
 W. M. WELLINGTON of Oxford.
 A. M. LYMAN of Montague.

Committee on Agricultural College and Education.

Messrs. JOHN BURSLEY of West Barnstable.
 C. K. BREWSTER of Worthington.
 WESLEY B. BARTON of Dalton.
 W. C. JEWETT of Worcester.
 ARTHUR A. SMITH of Colrain.

Committee on Experiments and Station Work.

Messrs. WM. H. SPOONER of Boston.
 T. H. GOODSPEED of Athol.
 N. I. BOWDITCH of Framingham.
 S. B. TAFT of Uxbridge.
 EDMUND HERSEY of Hingham.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. FRANCIS H. APPLETON of Peabody.
 J. S. APPLETON of Nantucket.
 H. A. TURNER of Norwell.
 E. W. BOISE of Blandford.
 J. W. GURNEY of Cummington.

Committee on Institutes and Public Meetings.

Messrs. F. W. SARGENT of Amesbury.
 EDMUND HERSEY of Hingham.
 W. B. BARTON of Dalton.
 HENRY C. COMINS of Northampton.
 H. H. GOODELL of Amherst.

The secretary is a member, *ex officio*, of each of the above committees.

DAIRY BUREAU.

Messrs. J. LEWIS ELLSWORTH of Worcester, 1903; C. D. RICHARDSON of West Brookfield, 1902; F. W. SARGENT of Amesbury, 1904.

Executive Officer and Secretary, J. W. STOCKWELL.
General Agent, GEO. M. WHITAKER, Boston.

SPECIALISTS.

By Election of the Board.

| | | |
|---|---------------------------------|----------|
| <i>Chemist,</i> | Dr. C. A. GOESSMANN, | Amherst. |
| <i>Entomologist,</i> | Prof. C. H. FERNALD, | Amherst. |
| <i>Botanist and Pomologist,</i> | Prof. S. T. MAYNARD, | Amherst. |
| <i>Veterinarian,</i> | Prof. JAMES B. PAIGE, | Amherst. |
| <i>Engineer,</i> | WM. WHEELER, | Concord. |
| <i>Ornithologist,</i> | E. H. FORBUSH, | Wareham. |

By Appointment of the Secretary.

Librarian, F. H. FOWLER, B.Sc., *First Clerk.*

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

BOARD OF TRUSTEES.

Term
expires

| | |
|---|------|
| SAMUEL C. DAMON of Lancaster, | 1903 |
| JAMES DRAPER of Worcester, | 1903 |
| HENRY S. HYDE of Springfield, | 1904 |
| MERRITT I. WHEELER of Great Barrington, | 1904 |
| WILLIAM R. SESSIONS of Springfield, | 1905 |
| CHARLES L. FLINT of Brookline, | 1905 |
| WILLIAM H. BOWKER of Boston, | 1906 |
| GEORGE H. ELLIS of Newton, | 1906 |
| J. HOWE DEMOND of Northampton, | 1907 |
| ELMER D. HOWE of Marlborough, | 1907 |
| NATHANIEL I. BOWDITCH of Framingham, | 1908 |
| WILLIAM WHEELER of Concord, | 1908 |
| ELIJAH W. WOOD of West Newton, | 1909 |
| CHAS. A. GLEASON of New Braintree, | 1909 |

MEMBERS EX OFFICIO.

His Excellency Governor W. MURRAY CRANE,
President of the Corporation.

| | |
|--|---|
| HENRY H. GOODELL, M.A., LL.D., | <i>President of the College.</i> |
| FRANK A. HILL, | <i>Secretary of the Board of Education.</i> |
| JAMES W. STOCKWELL, | <i>Secretary of the Board of Agriculture.</i> |

OFFICERS ELECTED BY THE BOARD OF TRUSTEES.

| | |
|--|---|
| HENRY S. HYDE of Springfield, | <i>Vice-President of the Corporation.</i> |
| JAMES W. STOCKWELL of Sutton, | <i>Secretary.</i> |
| Prof. GEO. F. MILLS of Amherst, | <i>Treasurer.</i> |
| CHARLES A. GLEASON of New Braintree, | <i>Auditor.</i> |

BOARD OF OVERSEERS.

The State Board of Agriculture.

EXAMINING COMMITTEE OF THE BOARD OF AGRICULTURE.

Messrs. BURSLEY, BREWSTER, BARTON, JEWETT and SMITH.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL
COLLEGE.

| | |
|---|-------------------------------------|
| HENRY H. GOODELL, M.A., LL.D., | <i>Director.</i> |
| WILLIAM P. BROOKS, B.Sc., | <i>Agriculturist.</i> |
| SAMUEL T. MAYNARD, B.Sc., | <i>Horticulturist.</i> |
| CHARLES H. FERNALD, Ph.D., | <i>Entomologist.</i> |
| HENRY T. FERNALD, Ph.D., | <i>Assistant Entomologist.</i> |
| CHAS. A. GOESSMANN, Ph.D., LL.D., | <i>Chemist (Fertilizers).</i> |
| JOSEPH B. LINDSEY, Ph.D., | <i>Chemist (Foods and Feeding).</i> |
| GEORGE E. STONE, Ph.D., | <i>Botanist.</i> |
| J. E. OSTRANDER, C.E., | <i>Metcorologist.</i> |

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF THE LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

| NAME. | PRESIDENT. | SECRETARY. | TREASURER. |
|--|----------------------------------|-------------------------------------|------------------------------------|
| Amesbury and Salisbury,* . . . | J. J. Mason, Amesbury. | A. H. Fielden, Amesbury. | J. A. Davis, Amesbury. |
| Barnstable County, . . . | D. Gorham Bacon, Yarmouth. | T. C. Day, Barnstable. | A. F. Sherman, Barnstable. |
| Berkshire, . . . | H. P. Jacques, Lenox. | J. W. Lewis, Pittsfield. | A. E. Malcolm, Pittsfield. |
| Blackstone Valley, . . . | Samuel B. Taft, Uxbridge. | Augustus Story, Uxbridge. | L. A. Seagrave, Uxbridge. |
| Bristol County, . . . | Herbert A. Dean, Berkley. | Carleton F. Sanford, Taunton. | Charles Bliss, Taunton. |
| Deerfield Valley, . . . | E. P. Williams, Shelburne. | S. W. Hawkes, Charlemont. | E. F. Haskins, Charlemont. |
| Eastern Hampden, . . . | O. E. Bradley, Monson. | L. E. Chandler, Palmer. | L. E. Chandler, Palmer. |
| Essex, . . . | Francis H. Appleton, Peabody. | J. M. Danforth, Lynnfield. | W. S. Nichols, Salem. |
| Franklin County, . . . | Frank O. Wells, Greenfield. | Henry J. Field, Greenfield. | Henry J. Field, Greenfield. |
| Hampshire, . . . | Henry E. Paige, Amherst. | Ralph E. Smith, Amherst. | Ralph E. Smith, Amherst. |
| Hampshire, Franklin and Hampden, . . . | J. F. Burt, Easthampton. | C. A. Montgomery, Northampton. | D. J. Wright, Northampton. |
| Highland, . . . | Henry S. Pease, Middlefield. | J. T. Bryan, Middlefield. | Henry S. Pease, Middlefield. |
| Hillside, . . . | R. M. Porter, Cummington. | C. M. Cudworth, Cummington. | D. E. Lyman, Cummington. |
| Hingham,* . . . | U. S. Bates, Hingham. | William H. Thomas, Hingham. | Reuben Sprague, Hingham. |
| Hoosac Valley, . . . | F. D. Stafford, North Adams. | A. P. Carpenter, North Adams. | M. R. Ford, North Adams. |
| Housatonic, . . . | N. B. Turner, Great Barrington. | F. H. Briggs, Great Barrington. | O. C. Bidwell, Great Barrington. |
| Manufacturers' Agricultural, . . . | S. O. Bigney, Attleborough. | Wm. H. Pond, Attleborough. | W. W. Sherman, North Attleborough. |
| Marshfield,* . . . | H. A. Oakman, North Marshfield. | I. H. Hatch, North Marshfield. | M. H. Kent, Marshfield. |
| Martha's Vineyard, . . . | B. T. Hillman, Edgartown. | F. A. Look, West Tisbury. | Geo. H. Luce, West Tisbury. |
| Massachusetts Horticultural, . . . | O. B. Hadwen, Worcester. | N. T. Kidder, Boston. | C. E. Richardson, Cambridge. |
| Massachusetts Society for Promoting Agriculture, . . . | C. S. Sargent, Brookline. | F. H. Appleton, Peabody. | R. M. Saltonstall, Newton. |
| Middlesex North, . . . | H. S. Perlman, Chelmsford. | Geo. B. Coburn, Lowell. | S. Drewett, Lowell. |
| Middlesex South, . . . | S. O. Staples, South Framingham. | G. E. Harrington, South Framingham. | S. B. Bird, Framingham. |
| Nantucket, . . . | H. G. Worth, Nantucket. | J. F. Murphy, Nantucket. | Asa C. Jones, Nantucket. |

* And horticultural.

AGRICULTURAL SOCIETIES, ETC. — *Concluded.*

| NAME. | PRESIDENT. | SECRETARY. | TREASURER. |
|---|--------------------------------------|--------------------------------|--------------------------------|
| Oxford, | O. F. Joslin, Oxford. | H. H. Sigourney, Oxford. | H. H. Sigourney, Oxford. |
| Plymouth County, | Augustus Pratt, North Middleborough. | G. M. Hooper, Bridgewater. | Geo. M. Hooper, Bridgewater. |
| Spencer (Farmers' and Mechanics' Association), | Edward Warren, Leicester. | H. H. Capen, Spencer. | H. H. Capen, Spencer. |
| Union,* | H. K. Herrick, Blandford. | E. W. Boise, Blandford. | John E. Cooney, Blandford. |
| Weymouth (Ag'l and Ind.), | Gordon Willis, South Weymouth. | T. L. Tirrell, South Weymouth. | E. J. Fitcher, South Weymouth. |
| Worcester, | H. S. Stockwell, Sutton. | H. S. Hastings, Worcester. | H. S. Hastings, Worcester. |
| Worcester East, | John E. Thayer, Lancaster. | Warren Goodale, Clinton. | Lucius Field, Clinton. |
| Worcester North-west (Agricultural and Mechanical), | Dr. James Oliver, Athol. | Albert Ellsworth, Athol. | F. G. Amsden, Athol. |
| Worcester South, | C. D. Paige, Southbridge. | C. V. Corey, Sturbridge. | C. V. Corey, Sturbridge. |
| Worcester County West, | Jesse Allen, Oakham. | Matthew Walker, Barre. | Chas. H. Follansby, Barre. |

* And horticultural.

HORTICULTURAL SOCIETIES.

| NAME. | LOCATION. | PRESIDENT. | SECRETARY. |
|--------------------------------|-----------------------------|---------------------------------|--|
| Cape Ann, | Gloucester, | Bennett Griffith, Gloucester. | William D. Lufkin, Gloucester. |
| Haverhill, | Haverhill, | Walter Goodrich, Haverhill. | Mrs. William M. Webster, Haverhill. |
| Hampden County, | Springfield, | Jacob C. Lutz, Springfield. | William F. Gale, City Hall, Springfield. |
| Houghton, | Lynn, | Walter B. Allen, Lynn. | Miss Ruth S. Wood, Lynn. |
| Lenox, | Lenox, | A. J. Loveless, Lenox. | Jos. W. Martin, Lenox. |
| Massachusetts, | The State, | O. B. Hadwen, Worcester. | N. T. Kidder, Boston. |
| Newton, | Newton, | L. H. Farlow, Newton. | L. H. Farlow, Newton. |
| Springfield Amateur, | Springfield, | W. T. Hutchins, Indian Orchard. | Chas. L. Burr, Springfield. |
| Worcester County, | Worcester County, | O. B. Hadwen, Worcester. | Adin A. Hixon, Worcester. |

FARMERS' AND MECHANICS' ASSOCIATIONS.

| | | | |
|------------------------------------|------------------------|------------------------------------|---|
| Bolton, | Bolton, | Henry F. Haynes, Bolton. | Wm. M. Brigham, Bolton. |
| Leominster, | Leominster, | George M. Kendall, Leominster. | C. C. Foster, Leominster. |
| Middlesex and Worcester, | Hudson, | Oliver Sawyer, Hudson. | Josiah S. Welsh, Hudson. |
| Needham, | Needham, | Merritt S. Keith, Wellesley Hills. | Chas. C. J. Spear, Charles River Village. |
| Oakham, | Oakham, | H. A. Crawford, Oakham. | H. W. Lincoln, Oakham. |
| Princeton, | Princeton, | J. E. F. Mirick, Princeton. | J. E. Merriam, Princeton. |
| Westminster, | Westminster, | T. F. Sweet, Gardner. | H. J. Partridge, Westminster. |

FARMERS' AND MECHANICS' CLUBS.

| | | | |
|------------------------|------------------------|------------------------------------|--------------------------------|
| Ashburnham, | Ashburnham, | E. J. Forristal, South Ashburnham. | Walter E. Jeffs, Ashburnham. |
| Ashby, | Ashby, | W. O. Loveland, Ashby. | W. J. Smith, Ashby. |
| Belchertown, | Belchertown, | D. F. Shumway, Belchertown. | Geo. H. B. Green, Belchertown. |
| Groton, | Groton, | T. Lawrence Motley, Groton. | Charles Woolley, Groton. |
| Holden, | Holden, | A. L. Potter, Holden. | Florence E. Newell, Holden. |
| Pepperell, | Pepperell, | C. A. Dennen, Pepperell. | H. W. Hutchinson, Pepperell. |
| Shirley, | Shirley, | H. S. Hazen, Shirley. | M. W. Longley, Shirley Centre. |
| Shrewsbury, | Shrewsbury, | E. A. Bartlett, Shrewsbury. | F. J. Stone, Shrewsbury. |
| Wilmington, | Wilmington, | Chas. J. Sargent, Wilmington. | Edw. M. Nichols, Wilmington. |

FARMERS' CLUBS.

| NAME. | LOCATION. | PRESIDENT. | SECRETARY. |
|---------------------------------|----------------------------|----------------------------------|-------------------------------------|
| Ashfield, | Ashfield, | John M. Sears, Ashfield. | A. G. Howes, Ashfield. |
| Boxborough, | Boxborough, | Frank A. Patch, Littleton. | C. T. Wetherbee, West Acton. |
| Buckland, | Buckland, | W. D. Forbes, Buckland. | Eli C. Maynard, Buckland. |
| Chamberlain District, | Worcester, | Pliny Moore, Worcester. | P. F. Sears, Worcester. |
| East Charlemont, | East Charlemont, | L. H. Richmond, East Charlemont. | Geo. H. Wheeler, East Charlemont. |
| Easthampton, | Easthampton, | E. H. Clark, Easthampton. | C. W. Smith, Easthampton. |
| Franklin, | Franklin, | Thomas B. Allen, Franklin. | L. W. Daniels, Franklin. |
| Halifax, | Halifax, | Otis Pratt, Halifax. | Mrs. Geo. W. Hayward, Halifax. |
| Huntington, | Huntington, | C. H. Strong, Norwich. | H. W. Stickney, Norwich. |
| Lancaster, | Lancaster, | Geo. F. Morse, South Lancaster. | F. A. Hanaford, South Lancaster. |
| New Braintree, | New Braintree, | Luther Crawford, New Braintree. | Mrs. Horatio Moore, New Braintree. |
| New Salem, | New Salem, | D. F. Carpenter, Millington. | Willard Putnam, Cooleyville. |
| Rehoboth, | Rehoboth, | Dr. C. H. Raymond, Rehoboth. | C. W. Goff, South Rehoboth. |
| Rowley, | Rowley, | J. D. Dodge, Rowley. | T. P. Hale, Rowley. |
| Royalston, | Royalston, | - - - - - | G. E. Pierce, Royalston. |
| Rutland, | Rutland, | Wm. C. Temple, Rutland. | Mrs. W. G. Wales, Rutland. |
| South Bristol, | New Bedford, | Franklyn Howland, Acushnet. | Allen Russell, Jr., Acushnet. |
| Tatnuck, | Worcester, | Henry E. Rich, Worcester. | H. Ward Moore, Worcester. |
| Upton, | Upton, | Geo. H. Stoddard, Upton. | Francis T. Nelson, Upton. |
| West Brookfield, | West Brookfield, | S. H. Reed, West Brookfield. | L. H. Chamberlain, West Brookfield. |
| West Newbury, | West Newbury, | Samuel E. Emery, Newburyport. | Parker H. Nason, West Newbury. |
| West Peabody, | West Peabody, | Mrs. F. C. Durkee, West Peabody. | Bertha G. Small, West Peabody. |
| Wilbraham, | Wilbraham, | B. F. Green, North Wilbraham. | Henry M. Bliss, Wilbraham. |

MISCELLANEOUS.

| | | | |
|--|----------------------------|----------------------------------|---------------------------------|
| Agricultural Library Association, . . . | Swansea, . . . | S. G. Arnold, Swansea Village. | A. E. Arnold, Swansea Centre. |
| Boston Market Gardeners' Association, . . . | Boston and vicinity, . . . | W. W. Rawson, Arlington. | J. B. Shurtleff, Jr., Revere. |
| Bristol Co. Fruit Growers' Association, . . . | Dighton, . . . | J. E. Sears, Dighton. | Wm. P. Eddy, Dighton. |
| Bay State Agricultural Society, . . . | The State, . . . | C. M. Weld, Boston. | N. I. Bowditch, Framingham. |
| Brockton Agricultural Society, . . . | Brockton, . . . | Henry W. Robinson, Brockton. | Balis Sanford, Brockton. |
| Burlington Agricultural Society, . . . | Burlington, . . . | Fernald E. Hamm, Lexington. | Samuel Sewall, Burlington. |
| Cranberry Growers' Association, . . . | Cape Cod District, . . . | Emulous Small, Harwichport. | Franklin Crocker, Hyannis. |
| Farmers' and Gardeners' Club, . . . | Hanson, . . . | George F. Simpson, Hanson. | F. S. Thomas, M.D., Hanson. |
| Franklin Harvest Club, . . . | Connecticut Valley, . . . | Seth S. Warner, Northampton. | C. B. Lyman, Southampton. |
| Hampden Agricultural Society, . . . | Springfield, . . . | C. W. Benis, Longmeadow. | E. S. Batchelder, Springfield. |
| Hampden Harvest Club, . . . | Connecticut Valley, . . . | The members alternately. | C. A. Judd, South Hadley Falls. |
| Massachusetts Creamery Association, . . . | The State, . . . | C. M. Bull, Springfield. | A. M. Lyman, Montague. |
| Massachusetts Forestry Association, . . . | The State, . . . | Dr. Henry P. Walcott, Cambridge. | Edwin A. Start, Medford. |
| Massachusetts Fruit Growers' Association, . . . | The State, . . . | H. O. Mead, Lunenburg. | C. A. Whitney, Upton. |
| Middlesex East Agricultural Association, . . . | Wakefield, . . . | Frank P. Bennett, Saugus. | Charles Talbot, Montrose. |
| Westborough Agricultural Society, . . . | Westborough, . . . | John B. Fitch, Westborough. | George M. Howe, Westborough. |
| Worcester County Bee-keepers' Association, . . . | - . . . | E. D. Goddard, Grafton. | C. R. Russell, Worcester. |
| Worcester North Agricultural Society, . . . | Fitchburg, . . . | W. H. Laws, Ashburnham. | John H. White, Fitchburg. |
| Young People's Agricultural Club, . . . | Wilbraham, . . . | B. F. Green, North Wilbraham. | Henry M. Bliss, Wilbraham. |

MASSACHUSETTS PATRONS OF HUSBANDRY.

OFFICERS OF THE STATE GRANGE, 1902.

| | |
|-----------------------------------|---|
| Master, | George S. Ladd of Sturbridge. |
| Overseer, | Carlton D. Richardson of West Brookfield. |
| Lecturer, | Charles H. Rice of Leominster. |
| Steward, | John E. Gifford of Sutton. |
| Assistant Steward, | Herbert Sabin of Amherst. |
| Chaplain, | Rev. A. H. Wheelock of Millis. |
| Treasurer, | Hon. F. A. Harrington of Worcester. |
| Secretary, | Wm. N. Howard of South Easton. |
| Gate Keeper, | I. H. Lamb of Stoughton. |
| Pomona, | Miss Mary E. Cutler of Holliston. |
| Flora, | Mrs. Ethel C. Plumb of Springfield. |
| Ceres, | Mrs. Mary E. Jewett of Worcester. |
| Lady Assistant Steward, | Mrs. S. Ella Southland of Athol. |

EXECUTIVE COMMITTEE.

| | |
|-------------------------------|--------------|
| Elmer D. Howe, | Marlborough. |
| C. A. Dennen, | Pepperell. |
| George L. Clemence, | Southbridge. |

GENERAL DEPUTY.

| | |
|----------------------------------|------------------|
| Carlton D. Richardson, | West Brookfield. |
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POMONA DEPUTIES.

| | |
|-----------------------------|---------------|
| Hon. M. A. Morse, | Belchertown. |
| Hon. F. A. Patch, | Littleton. |
| Dr. James Oliver, | Athol Centre. |

SUBORDINATE GRANGE DEPUTIES.

| | |
|------------------------------|-------------------|
| Marcellus Boynton, | Assonet. |
| E. E. Chapman, | Ludlow. |
| Geo. E. Crosby, | Tewksbury. |
| C. C. Colby, | Hubbardston. |
| F. H. Stevens, | West Acton. |
| C. A. Stinson, | Royalston. |
| T. E. Flarity, | Townsend. |
| E. A. Emerson, | Haverhill. |
| B. H. Ellis, | Westfield. |
| Geo. W. Sherman, | Brimfield. |
| L. R. Smith, | Hadley. |
| M. D. Herrick, | North Orange. |
| C. O. Littlefield, | South Framingham. |
| E. H. Gilbert, | Stoughton. |
| W. D. Seaver, | Gardner. |
| L. H. Cudworth, | Oxford. |

SPECIAL DEPUTIES.

| | |
|--------------------------|---------------|
| Wm. N. Howard, | South Easton. |
| F. H. Plumb, | Springfield. |
| Herbert Sabin, | Amherst. |

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---------------------------------|--------------------------------------|-------------------------------------|---|
| <i>Pomona Granges.</i> | | | |
| Middlesex and Norfolk, No. 1, | J. Herbert Baker, Medfield. | G. P. Holbrook, Norfolk. | Mrs. Geo. L. Whitney, So. Frammingham. |
| Essex County, No. 2, | Herbert L. Foster, North Andover. | Mrs. E. M. Newell, West Newbury. | Mrs. Matilda B. Lund, West Boxford. |
| Worcester and Middlesex, No. 3, | S. R. Walker, North Leominster. | Mrs. Lizzie E. Starr, Pepperell. | Geo. A. Wilder, Townsend. |
| Franklin and Worcester, No. 4, | Charles A. Stinson, Athol. | S. C. Perham, Athol. | Luther E. Stewart, Athol. |
| Worcester West, No. 5, | Albert Needham, Ashburnham. | H. A. Whitney, Gardner. | Miss Alice E. Munroe, Gardner. |
| Berkshire County, No. 6, | Mrs. S. I. Parker, Dalton. | J. S. Cole, Hinsdale. | Mrs. E. R. Morse, Dalton. |
| Worcester Central, No. 7, | George M. Allen, Auburn. | Adin A. Hixon, Worcester. | Mrs. Ellen M. Hayward, Millbury. |
| Hampshire County, No. 8, | Leslie R. Smith, Hadley. | Mrs. Dwight Cleary, Williamsburg. | Mrs. T. E. Brigham, Amherst. |
| Worcester South-west, No. 9, | Wm. N. Hinman, Sturbridge. | Mrs. Rose F. Ladd, Sturbridge. | Mrs. Mary J. Morse, Southbridge. |
| Worcester and Norfolk, No. 10, | William P. Greenwood, South Milford. | William J. Taylor, Blackstone. | A. W. Gaskill, Mendon. |
| Borough, No. 11, | Frank A. Patch, Littleton. | Mrs. Mary C. Graham, Westborough. | Mrs. S. Mabel Thompson, Woodville. |
| Springfield, No. 12, | E. E. Chapman, Ludlow. | Mrs. Bertha Taylor, Granby. | Mrs. Carrie L. Hayward, Agawam. |
| Old Colony, No. 13, | Marcellus Boynton, Assonet. | Ernest H. Gilbert, Stoughton. | Mrs. Alida N. Stevens, South Braintree. |
| Worcester East, No. 14, | Marshall Walcott, Bolton. | Mrs. Charles H. Rice, Leominster. | Mrs. E. T. Cunningham, Lancaster. |
| Quabaug, No. 15, | W. R. Smith, West Brookfield. | A. C. Bliss, North Brookfield. | Miss Carrie A. Smith, West Brookfield. |
| Middlesex North, No. 16, | Geo. A. H. Richardson, Draent. | Geo. E. Crosby, Tewksbury. | Mrs. M. A. Robey, Westford. |
| <i>Subordinate Granges.</i> | | | |
| Northfield, No. 3, | Mrs. Nellie Callendar, Northfield. | Mrs. Nellie Chamberlin, Northfield. | Mrs. Elsie L. Saunders, Northfield. |
| Groton, No. 7, | James P. Fitch, Groton. | Mrs. Olive M. Wilson, Groton. | Mrs. Ella P. Woolley, Groton. |
| Barre, No. 9, | John L. Smith, Barre. | Mrs. Lizzie Patterson, Barre. | Mrs. Minnie E. Rice, Barre. |
| "Hope" of Hadley, No. 15, | Burton W. Cogswell, Hadley. | Leslie R. Smith, Hadley. | John W. Marsh, Hadley. |
| Amherst, No. 16, | Charles H. Hooker, Amherst. | Mrs. Rufus Hinekey, Amherst. | Carrie C. Sabin, Amherst. |
| Cheshire, No. 17, | W. B. Cole, Cheshire. | Orrin C. Martin, Cheshire. | Jabez C. Jenks, Adams. |
| Hinsdale, No. 19, | Thomas F. Barker, Hinsdale. | Frank F. Watkins, Hinsdale. | John S. Cole, Hinsdale. |
| Westfield, No. 20, | Chas. M. Gardner, Westfield. | Mrs. William Arnold, Westfield. | Miss Annette Sackett, Westfield. |
| Worcester, No. 22, | Edward H. Moore, Worcester. | James Draper, Worcester. | Mrs. Nancy E. Moore, Worcester. |

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---|------------------------------------|--|--------------------------------------|
| Dalton, No. 23, | W. B. Warren, Dalton. | Miss Blanche M. Barton, Dalton. | W. H. Woodworth, Dalton. |
| Blandford, No. 24, | Ely Wyman, Blandford. | Willis L. Karr, Blandford. | W. J. Peebles, Blandford. |
| New Lenox, No. 26, | Fred D. Sears, New Lenox. | Mrs. E. A. Howland, New Lenox. | George M. Parker, New Lenox. |
| Easthampton, No. 27, | Frank R. Carter, Easthampton. | W. M. Gaylord, Easthampton. | Mrs. Jennie A. Carter, Easthampton. |
| Richmond, No. 32, | S. M. Loveland, Richmond. | W. H. Terrell, Richmond. | Jesse H. Fairfield, Jr., Richmond. |
| Montgomery, No. 45, | L. O. Moore, Montgomery. | C. H. Cooley, Westfield. | Miss Agnes E. Moore, Montgomery. |
| Southwick, No. 46, | Charles J. Root, Southwick. | Mrs. Edith M. Trench, Southwick. | Nelson J. Trench, Southwick. |
| "Highland" of Huntington, No. 48, | W. A. Munson, Huntington. | Mrs. W. A. Munson, Huntington. | H. R. Gooch, Huntington. |
| "Granite" of South Worthington, No. 49, | Hinckley D. Bradley, Ringville. | Mrs. Reuben Drake, Ringville. | Mrs. Emma Thrasher, So. Worthington. |
| Sterling, No. 53, | Henry S. Sawyer, Sterling. | Louis A. Stuart, Sterling. | Charles B. Tolman, Sterling. |
| Springfield, No. 54, | C. J. Roadstrand, Springfield. | Mrs. A. C. Baker, Springfield. | Miss Bertha E. Baker, Springfield. |
| Cummington, No. 56, | Ward A. Harlow, Cummington. | Mrs. Francis Streeter, Cummington. | L. W. Pettingill, Cummington. |
| Auburn, No. 60, | William Gilbert, Auburn. | M. L. Hervey, Auburn. | Mrs. Eleanor W. Barrows, Auburn. |
| "Union" of Belchertown, No. 64, | E. A. Randall, Belchertown. | Geo. B. Jackson, Belchertown. | Mrs. E. A. Randall, Belchertown. |
| Brimfield, No. 65, | Orrin Hicks, Brimfield. | Mabel N. Brown, Brimfield. | Jessie Fairfield, Brimfield. |
| Charlenton, No. 66, | T. M. Toutan, Charlenton. | Homer Sherman, Charlenton. | S. W. Hawkes, Charlenton. |
| Hardwick, No. 67, | Williams A. Newcomb, Hardwick. | Mrs. F. E. Ruggles, Gilbertville. | John N. Hillman, Hardwick. |
| Ashfield, No. 69, | George G. Henry, Ashfield. | Allison G. Howes, Ashfield. | Miss Mary E. Sears, Ashfield. |
| Phillipston, No. 70, | A. D. Clifford, Phillipston. | Miss Mimma B. Hager, Templeton. | Mrs. Cora A. Duntton, Phillipston. |
| Leyden, No. 71, | F. O. Darling, Leyden. | Mrs. Julia L. Davenport, Leyden. | Mrs. J. K. Dennison, Leyden. |
| "Prescott" of Pepperell, No. 73, | George A. Mahoney, East Pepperell. | George P. Parker, Pepperell. | E. Charles Howard, East Pepperell. |
| Colrain, No. 76, | George W. Cary, Griswoldville. | Mrs. J. E. Davenport, Griswoldville. | Mrs. S. E. Temple, Shattuckville. |
| Holden, No. 78, | T. Walter Howe, Holden. | Mrs. M. E. Hubbard, Holden. | Mrs. Ina M. Stanhope, Jefferson. |
| Spencer, No. 79, | Edson C. Bemis, Spencer. | P. Emerson, Spencer. | John W. Bigelow, Spencer. |
| "Manhan" of Southampton, No. 82, | C. S. Hooker, Holyoke. | Edgar R. Loomis, Southampton. | Mrs. C. P. Gridley, Southampton. |
| North Orange, No. 86, | Merrill D. Herrick, North Orange. | Mrs. Mary M. Richardson, North Orange. | Mrs. Martha A. Cheney, North Orange. |

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| Lee, No. 88, | James E. Seacord, Lee. | Mrs. H. J. Voght, Lee. |
| Charlton, No. 92, | Mrs. Ananda L. Putnam, Charlton Depot. | Mrs. Rosa E. Bowers, Charlton Depot. |
| Grafton, No. 93, | Mrs. M. Lizzie Johnson, North Grafton. | Miss Lula E. Whitney, Grafton Centre. |
| Petersham, No. 95, | S. B. Cook, Petersham. | Mrs. Mary E. Prouty, Petersham. |
| Shrewsbury, No. 101, | Mrs. Jeremy Stone, Shrewsbury. | Mrs. Frank T. Carey, Shrewsbury. |
| Stow, No. 103, | Mrs. E. F. Wheeler, Stow. | Mrs. I. M. Lewis, Stow. |
| "Garfield" of No. Dana, No. 104, | Lyman Randall, North Dana. | Mrs. Lena M. Randall, North Dana. |
| Marlborough, No. 105, | E. N. Stratton, Marlborough. | Mrs. Elmer D. Howe, Marlborough. |
| West Boylston, No. 106, | William E. Parker, West Boylston. | Miss Hattie L. Goodale, West Boylston. |
| Millbury, No. 107, | Miss Mabel L. Rice, Millbury. | E. P. Davidson, West Millbury. |
| Hudson, No. 108, | Mrs. Mary J. Houghton, Hudson. | Mrs. Mary E. Lawrence, Hudson. |
| Sutton, No. 109, | John E. Gifford, Sutton. | Miss Sarah M. Mills, Sutton. |
| Sherborn, No. 110, | Mrs. Frank Sylvester, South Sherborn. | Mrs. Geo. L. Whitney, So. Framingham. |
| Boylston, No. 111, | Miss Maude H. Shattuck, Boylston Centre. | Mrs. Henrietta M. Andrews, Boylston Centre. |
| "East Medway" of Millis, No. 112, | W. P. Clark, Millis. | Chester LaCroix, Millis. |
| Framingham, No. 113, | Mrs. L. M. Marston, Framingham. | Harry B. Walkup, Framingham. |
| Medfield, No. 114, | Miss Mabel H. Ellis, Harding. | Mrs. W. W. Preston, Medfield. |
| Holliston, No. 115, | Miss Mary E. Cutler, Holliston. | Mrs. Nellie V. Pope, Holliston. |
| Westborough, No. 116, | Charles Jones, Southville. | Mrs. Nellie M. Guild, Westborough. |
| Dover, No. 117, | Miss Georgie Chamberlain, Westwood. | Mrs. I. M. Packard, Charles River. |
| Southborough, No. 118, | Mrs. Annie S. Taylor, Cordaville. | Mrs. Mary A. Klebes, Southborough. |
| Northborough, No. 119, | Mrs. Fannie B. Hildreth, Northborough. | Miss E. M. Cutler, Northborough. |
| Lancaster, No. 120, | Mrs. E. T. Cunningham, Lancaster. | Miss Mary B. Evans, Clinton. |
| Sudbury, No. 121, | Miss Ida E. Goodnow, South Sudbury. | Mrs. Emma F. Powers, Sudbury Centre. |
| Templeton, No. 122, | George E. French, Templeton. | Mrs. Julia Lane, Templeton. |
| Oxford, No. 123, | Miss Alice M. Brady, Oxford. | Mrs. B. W. Morse, Oxford. |
| Ashland, No. 124, | Mrs. Eliza Burr, Ashland. | Mrs. M. F. Bishop, Ashland. |
| Upton, No. 125, | Mrs. E. Gertrude Aldrich, West Upton. | Mrs. L. Jennie Chapman, West Upton. |
| Hubbardston, No. 126, | Mrs. Edmund S. Bennett, Hubbardston. | George E. Morse, Hubbardston. |
| Amesbury, No. 127, | Miss Nellie A. Huntington, Amesbury. | Miss Annie F. Tucker, Amesbury. |
| North Andover, No. 128, | Miss Ida F. Carleton, North Andover. | Walter H. Hayes, North Andover Depot. |
| Gardner, No. 130, | Hamlin A. Whitney, Gardner. | Miss Mabel E. Cornwell, Gardner. |

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|--|---|--|---|
| Boxborough, No. 131, . . . | Frank A. Patch, Littleton. | Mrs. J. A. Littlefield, West Acton. | Mrs. E. A. Furbush, West Acton. |
| North Brookfield, No. 132, . . . | Mrs. Frances A. Cummings, North Brookfield. | Mrs. J. Georgia Stoddard, North Brookfield. | Miss Clara A. Anderson, North Brookfield. |
| Berlin, No. 134, . . . | Herbert L. Wheeler, Berlin. | Mrs. Jennie M. Keyes, Berlin. | Mrs. Ida Hartshorn, Berlin. |
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INDEX TO SECRETARY'S REPORT.

| | PAGE |
|--|-----------|
| Abandoned farms, concerning, | xviii |
| Actinomycosis in work of Cattle Commission, | 492 |
| Agricultural College, Massachusetts, concerning various departments at the, | 305, 307 |
| Agricultural College, Massachusetts, officers and trustees of the, | 516 |
| Agricultural College, Massachusetts, report to Legislature of Board of Agriculture acting as overseers of the, | 305 |
| Agricultural exhibitions, dates of, and assignment of inspectors to, | 290 |
| Agricultural organizations, directory of, | 513 |
| Agricultural purposes, legislative appropriations for, | xvii |
| Agricultural societies, committee on, report of, | 298 |
| Agricultural societies, concerning the, | viii |
| Agricultural societies, officers of, | 517 |
| Agricultural societies, returns of, | 502 |
| Agriculture, advance in, | xxii |
| Agriculture, Board of, annual meeting of the, | 281 |
| Agriculture, Board of, bulletins of the, published in crop reports, | 353 |
| Agriculture, Board of, changes in the, | viii, 281 |
| Agriculture, Board of, committee on agricultural societies of the, report of the, | 298 |
| Agriculture, Board of, committee on domestic animals and sanitation of the, report of the, | 299 |
| Agriculture, Board of, committee on experiments and station work of the, report of the, | 301 |
| Agriculture, Board of, committee on forestry, roads and roadside improvements of the, report of the, | 302 |
| Agriculture, Board of, committee on gypsy moth, insects and birds of the, report of the, | 313 |
| Agriculture, Board of, committee on institutes and public meetings of the, report of the, | 310 |
| Agriculture, Board of, Dairy Bureau of the, eleventh annual report of the, | 433 |
| Agriculture, Board of, executive committee of the, meetings of the, | 3 |
| Agriculture, Board of, fiftieth anniversary of the, concerning the, | 287 |
| Agriculture, Board of, librarian of the, report of the, | 320 |

| | |
|--|-------------|
| Agriculture, Board of influence of the, on the agriculture of the State, essay on, by John Bursley, | 331 |
| Agriculture, Board of, members, officers and committees, . v, 285, | 513 |
| Agriculture, Board of, public winter meeting of the, at Northampton, | 41 |
| Agriculture, Board of, publications of the, | xv |
| Agriculture, Board of, report of the, to the Legislature, acting as overseers of the Massachusetts Agricultural College, . . . | 305 |
| Agriculture, Board of, resolutions by the, on the death of Edward M. Thurston, | 297 |
| Agriculture, Board of, special meeting of the, | 295 |
| Agriculture, Board of, summer meeting of the, at Swansea, . . . | 7 |
| Agriculture, early history of, | 338 |
| Agriculture, monks in, the influence of the, address on, by H. H. Goodell, LL.D., | 8 |
| Agriculture in a system of public education, nature study and the need of, lecture on, by C. F. Hodge, Ph.D., | 200 |
| Agriculture in the common schools, teaching of, | 195 |
| Agriculture of the twentieth century demands, a lesson in economics: what the, essay on, by Dr. G. M. Twitchell, | 364 |
| Alfalfa, culture and value of, | 186 |
| Alvord, Major Henry E., lecture by, on dairying in France, . . . | 121 |
| Amesbury and Salisbury Agricultural and Horticultural Society, mortgage of property of the, | 4 |
| Animals and sanitation, report of committee on domestic, . . . | 299 |
| Anthrax, symptomatic, or blackleg, in work of Cattle Commission, | 482 |
| Apple canker, concerning, | 253 |
| Apple culture promising, | 235 |
| Apple growing, soil for, and management of, | 236, 242 |
| Apple trees, planting and care of, | 237 |
| Apples, new varieties of, concerning, | 241 |
| Appropriations for agricultural purposes, | xvii |
| Arsenate of lead as an insecticide, | 62, 98, 117 |
| Arsenical compounds for destroying insects, concerning, . . . | 97 |
| Birds, insectivorous, value of, | xiv |
| Blackleg vaccine, preparation and use of, | 483, 486 |
| Blackleg or symptomatic anthrax, concerning, | 482 |
| Board of Agriculture. See Agriculture, Board of. | |
| Board of Cattle Commissioners. See Cattle Commissioners, Board of. | |
| Boston butter market, statistics of, | 435 |
| Boston milk supply, statistics of, | 444 |
| Breeding, tree, concerning, | 238 |
| Breeding for dairy purposes, | 176, 384 |

| | PAGE |
|--|---------------|
| Bristol County Agricultural Society, concerning the, | 3, 283, 295 |
| Brown-tail moth, concerning the, | 88, 315 |
| Budding of King apple on Northern Spy stock, | 253 |
| Bull, importance of the, in the herd, | 385 |
| Bureau, Dairy, eleventh annual report of the, | 433 |
| Bursley, John, essay by, on cranberry culture in south-eastern Massachusetts, | 389 |
| Bursley, John, essay by, on the influence of the Board on the agriculture of the State, | 331 |
| Butter, imitation, concerning, | 436 |
| Butter, making and selling of, in France, | 123 |
| Butter market, concerning the, | 435 |
| Butter, renovated, concerning, | 440 |
| Calves, raising of, | 175, 192, 387 |
| Candage, R. G. F., address by, at Farmers' National Con- gress, | 338 |
| Candage, R. G. F., report by, on Farmers' National Congress at Sioux Falls, | 336 |
| Cattle, results of work by inspectors in quarantining, | 464, 473 |
| Cattle at fairs, admission fees for entry of, | 282 |
| Cattle Commissioners, Board of, annual report of the, | 459 |
| Cattle Commissioners, Board of, financial statement of the, | 466 |
| Cattle Commission, history and work of the, | 459 |
| Cattle industry, history and statistics of the, | 343 |
| Cheese, Cantal, concerning, | 129 |
| Cheese, Emmenthal, concerning, | 136 |
| Cheese, Gruyere, concerning, | 133 |
| Cheese making in France, concerning, | 129 |
| Cheese, Roquefort, concerning, | 130 |
| Civic virtues, the culture of the, address on, by Rev. Calvin Stebbins, | 28 |
| Climates, humid, irrigation in, essay on, by Prof. C. S. Phelps, | 398 |
| Clover as a cover crop, growing of crimson, | 244, 250 |
| Clover, growing of, | 70 |
| Clover sod for potatoes, | 65 |
| College, Massachusetts Agricultural. <i>See</i> Agricultural College. | |
| Colorado potato beetle, concerning the, | 51 |
| Colored race, the, and its relation to the productive industries of this country, lecture on, by Booker T. Washington, LL.D., | 255 |
| Cooley, Prof. F. S., essay by, on selection and improvement of the dairy herd, | 377 |
| Cotentin strain of cattle, concerning the, | 121 |
| Cotton, history and production of, | 346 |
| Cow, how to know a good, | 380 |
| Cows, how to secure good, | 383 |

| | PAGE |
|---|----------|
| Cranberry culture in south-eastern Massachusetts, essay on, by John Bursley, | 389 |
| Cranberry insects, concerning, | 393 |
| Crop reports, concerning, | xvi |
| Crops of 1901, concerning the, | xxv |
| Crops, injuries to, by insect pests, | xii |
| Dairy animals should be bred, age at which, | 192 |
| Dairy Bureau, detective work of the, | 434 |
| Dairy Bureau, educational work of the, | 451 |
| Dairy Bureau, eleventh annual report of the, | 433 |
| Dairy Bureau, financial statement of the, | 456 |
| Dairy Bureau, roster of the, | 432 |
| Dairy economics, lecture on, by Ex-Gov. W. D. Hoard, | 168 |
| Dairy herd, selection and improvement of the, essay on, by Prof. F. S. Cooley, | 377 |
| Dairy purposes, specific breeding for, | 176, 384 |
| Dairy laws, codification of, concerning, | 451 |
| Dairying, cleanliness, order and neatness in, importance of, . | 173 |
| Dairying in France, lecture on, by Maj. Henry E. Alvord, . . | 121 |
| Dairying, winter, concerning, | 174 |
| Directory of agricultural and similar associations, | 513 |
| Economics, a lesson in: what the agriculture of the twentieth century demands, essay on, by Dr. G. M. Twitchell, | 364 |
| Economics, dairy, lecture on, by Ex-Gov. W. D. Hoard, | 168 |
| Education, public, nature study and the need of agriculture in a system of, lecture on, by C. F. Hodge, Ph.D., | 200 |
| Elm leaf beetle, concerning the, | 82, 109 |
| Emmenthal cheese, concerning the making of, | 136 |
| Executive committee of the Board of Agriculture, minutes of meetings, | 3 |
| Exhibitions, agricultural, dates of, and assignment of inspectors to, | 290 |
| Experiment Station, Hatch, officers of the, | 516 |
| Experiments and station work, report of committee on, | 301 |
| Experiments with irrigation on strawberries, | 410 |
| Fairs, admission fees for entry of cattle at, concerning, . . . | 282 |
| Fairs, dates of, and assignment of inspectors to, | 290 |
| Fall web worm, concerning the, | 92 |
| Farmers' clubs, officers of, | 520 |
| Farmers' institutes, concerning, | x, 310 |
| Farmers' National Congress at Sioux Falls, S. D., report of the delegates to the, by R. G. F. Candage, | 336 |

| | PAGE |
|---|---------------|
| Farming, poultry keeping as a principal feature of diversified, essay on, by John H. Robinson, | 416 |
| Farms, abandoned, concerning, | xviii |
| Farms, New England, the relation of fruit culture to the value of, lecture on, by George T. Powell, | 232 |
| Fernald, Dr. Henry T., essay by, on three common orchard scales, | 353 |
| Fertilizers for potatoes, | 47 |
| Flamande cattle, concerning, | 128 |
| Flea beetle, concerning the, | 51 |
| Forests and forest preservation, | xi |
| Forestry, Massachusetts, essay on, by Hon. Wm. R. Sessions, . | 322 |
| Forestry, roads and roadside improvements, report of committee on, | 302 |
| Fowler, F. H., report by, as librarian, | 320 |
| France, butter making and selling in, | 123 |
| France, cheese making in, concerning, | 129 |
| France, dairying in, lecture on, by Maj. Henry E. Alvord, . | 121 |
| Franklin County Agricultural Society, mortgage of property of, | 283 |
| Fruit culture to the value of New England farms, the relation of, lecture on, by George T. Powell, | 232 |
| Gardens, school, value of, | 219 |
| Glanders in work of Cattle Commission, | 475 |
| Glucose in spraying mixtures, value of, | 62, 111 |
| Goodell, Dr. H. H., address by, on the influence of the monks in agriculture, | 8 |
| Granges, officers of the, | 522 |
| Gruyère cheese, concerning the making of, | 133 |
| Gypsy moth, concerning the, | 84, 313 |
| Gypsy moth, insects and birds, report of the committee on, . | 313 |
| Gypsy moth committee, financial statement of the, | 317 |
| Hatch Experiment Station, officers of the, | 516 |
| Heifers, rearing and developing, | 175, 192, 387 |
| Hoard, Ex-Gov. W. D., lecture by, on dairy economics, . . . | 168 |
| Hodge, Dr. C. F., lecture by, on nature study and the need of agriculture in a system of public education, | 200 |
| Hog cholera, concerning, | 499 |
| Horses, history and value of, | 345 |
| Horticultural societies, officers of, | 518 |
| Husbandry, Patrons of, officers of, | 522 |
| Insect enemies of the cranberry, concerning the, | 393 |
| Insect enemies of the potato, concerning the, | 50 |
| Insect pests, loss to the State from, | xii |

| | |
|---|-------------|
| Insect problem, the shade-tree, lecture on, by A. H. Kirkland, M.S., | 77 |
| Insecticide, arsenate of lead as an, value of, | 62, 117 |
| Insecticides, kerosene and crude petroleum as, | 361 |
| Insecticides, kerosene emulsion and whale oil soap as, | 356, 362 |
| Insectivorous birds, value of, | xiv |
| Insects, arsenical compounds for destroying, | 97 |
| Inspectors in quarantining cattle, results of work by, | 464, 473 |
| Inspectors to fairs, assignment of, | 290 |
| Institutes, farmers', concerning, | x, 310 |
| Institutes and public meetings, report of committee on, | 310 |
| Irrigation experiments with strawberries, | 410 |
| Irrigation in humid climates, essay on, by Prof. C. S. Phelps, | 398 |
| Irrigation, some instances of successful, | 406 |
| Irrigation, suggestions regarding, | 412 |
| Jenkins, Dr. E. H., lecture by, on the latest results of experi- ments in the culture, cure and fermentation of tobacco, | 139 |
| Kerosene and kerosene emulsion as insecticides, | 356, 361 |
| King method of ventilation described, the, | 179 |
| Kirkland, A. H., lecture by, on the shade-tree insect problem, | 77 |
| Labor question in poultry keeping, the, | 426 |
| Larzac sheep, concerning, | 132 |
| Laws, dairy, codification of, | 451 |
| Lead, arsenate of, concerning, | 62, 98, 117 |
| Leaf burn, concerning, | 56 |
| Librarian, report of the, | 320 |
| London purple as an insecticide, | 97 |
| Massachusetts, annual loss in, by insect pests, | xii |
| Massachusetts, south-eastern, cranberry culture in, essay on, by John Bursley, | 389 |
| Massachusetts Agricultural College. <i>See</i> Agricultural College. | |
| Massachusetts crops, 1901, | xxv |
| Massachusetts forestry, essay on, by Hon. Wm. R. Sessions, | 322 |
| Massachusetts weather, 1901, | xxviii |
| Middlesex South Agricultural Society, mortgage of real estate of, | 3 |
| Milk, Boston, statistics of, | 444 |
| Milk in cities other than Boston, statistics of, | 449 |
| Milk laws, concerning the enforcement of, | 442 |
| Milk supply of Paris, concerning the, | 127 |
| Monks in agriculture, the influence of the, address on, by H. H. Goodell, LL.D., | 8 |

| | PAGE |
|---|--------|
| Nature leaflets, concerning, | xvi |
| Nature study and the need of agriculture in a system of public education, lecture on, by C. F. Hodge, Ph.D., | 200 |
| New England farms, the relation of fruit culture to the value of, lecture on, by George T. Powell, | 232 |
| Northampton, public winter meeting of the Board of Agriculture at, | 41 |
| Oleomargarine laws, concerning the enforcement of, | 436 |
| Orchard scales, three common, essay on, by Dr. Henry T. Fernald, | 353 |
| Organizations, agricultural, directory of, | 513 |
| Oyster shell scale, life history of and treatment for, | 353 |
| Paris, concerning the milk supply of, | 127 |
| Paris green as an insecticide, | 97 |
| Patrons of Husbandry, officers of, | 522 |
| Peach trees, method of pruning, | 251 |
| Petroleum, crude, as an insecticide, | 361 |
| Phelps, Prof. C. S., essay by, on irrigation in humid climates, | 398 |
| Pole-sweat of tobacco, prevention of, | 162 |
| Potato, insect enemies of the, | 50 |
| Potato beetle, concerning the, | 51 |
| Potato blight, concerning the, | 53, 55 |
| Potato culture, modern, lecture on, by Dr. Chas. D. Woods, | 45 |
| Potato culture, water in, importance of, | 49, 63 |
| Potato scab, concerning, | 57, 68 |
| Potato seed, concerning, | 46, 72 |
| Potatoes, clover sod for, value of, | 65 |
| Potatoes, fertilizers for, | 47 |
| Potatoes, formulas for use in spraying, | 60 |
| Poultry keeping as a principal feature of diversified farming, essay on, by John H. Robinson, | 416 |
| Poultry keeping compared, methods of, | 417 |
| Poultry keeping, combinations in, | 423 |
| Poultry keeping, exclusive, leaks in, | 420 |
| Poultry keeping, the labor question in, | 426 |
| Poultryman or farmer poultryman, which? | 416 |
| Powell, George T., lecture by, on the relation of fruit culture to the value of New England farms, | 232 |
| Publications of the Board of Agriculture, | xv |
| Rabies in work of Cattle Commission, | 496 |
| Renovated butter, concerning, | 440 |
| Resolutions on the death of Edward M. Thurston, | 297 |
| Returns of societies, | 502 |

| | PAGE |
|---|----------|
| Rice, history and production of, | 342 |
| Roads and roadside improvements, report of committee on forestry, | 302 |
| Robinson, John H., essay by, on poultry keeping as a principal feature of diversified farming, | 416 |
| Roquefort cheese, concerning the manufacture of, | 130 |
| Sanitation, report of committee on domestic animals and, | 299 |
| San José scale, concerning the, 81, 252, | 356 |
| San José scale, destroying the, by fumigation, | 362 |
| San José scale, food plants, distribution, enemies, | 358 |
| San José scale, life history of the, | 357 |
| San José scale, treatment for the, | 360 |
| Scales, three common orchard, essay on, by Dr. Henry T. Fernald, | 353 |
| School gardens, value and results of, | 219 |
| Schools, common, teaching of agriculture in the, | 195 |
| Scurfy scale, life history and treatment for the, | 355 |
| Season of 1901, progress of the, | xxv |
| Sessions, Hon. Wm. R., essay by, on Massachusetts forestry, | 322 |
| Shade-tree insect problem, the, lecture on, by A. H. Kirkland, M.S., | 77 |
| Sheep, Larzac, concerning, | 132 |
| Sheep industry, history and statistics of the, | 344 |
| Sioux Falls, S. D., report of delegates to Farmers' National Congress at, | 336 |
| Skim-milk to calves, feeding of, 175, 192, | 387 |
| Societies, agricultural. <i>See</i> Agricultural societies. | |
| Soil for apple growing, and management of, | 236, 242 |
| Spraying mixtures, use of glucose in, | 62, 111 |
| Spraying operations, cost of, | 103 |
| Spraying outfits, concerning, | 100, 113 |
| Spraying potatoes, formulas for use in, | 60 |
| Stables, ventilation of, | 178 |
| Stebbins, Rev. Calvin, address by, on the culture of the civic virtues, | 28 |
| Strawberries, experiments with irrigation on, | 410 |
| Swansea, summer meeting of the Board of Agriculture at, | 7 |
| Swine diseases in work of Cattle Commission, | 499 |
| Swine industry, history and statistics of the, | 344 |
| Texas fever in work of Cattle Commission, | 495 |
| Thurston, Edward M., resolutions on the death of, | 297 |
| Tree breeding, concerning, | 238 |
| Tobacco, culture, cure and fermentation of, the latest results of experiments in the, lecture on, by Dr. E. H. Jenkins, | 139 |

| | PAGE |
|--|--------|
| Tobacco, feather-leaf, concerning, | 158 |
| Tobacco, fermentation of, concerning the, | 153 |
| Tobacco, pole-sweat of, drying out barns to prevent the, | 163 |
| Tobacco, steaming of, | 162 |
| Tobacco under cheese cloth shade, growing of, | 142 |
| Tuberculosis in work of Cattle Commission, | 468 |
| Tussock moth, concerning the, | 90 |
| Twitchell, Dr. Geo. M., essay by, on a lesson in economics: what the agriculture of the twentieth century demands, | 364 |
| Vaccine, blackleg, directions for the use of, | 483 |
| Vaccine, blackleg, preparation of, | 486 |
| Ventilation of stables, concerning the King method of, | 179 |
| Ware pump, concerning the, | 117 |
| Washington, Dr. Booker T., lecture by, on the colored race and its relation to the productive industries of this country, | 255 |
| Water in potato culture, importance of, | 49, 63 |
| Weather, Massachusetts, 1901, | xxviii |
| Whale oil soap as an insecticide, | 362 |
| Wheat, history and production of, | 338 |
| Willow weevil, imported, concerning the, | 95 |
| Woods, Dr. Chas. D., lecture by, on modern potato culture, | 45 |

FOURTEENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1902.



BOSTON :
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1902.



HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

OFFICERS.

| | | | | | |
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| ——— ——— | . | . | . | . | <i>Assistant Horticulturist.</i> |
| HENRY L. BODFISH, | . | . | . | . | <i>Observer.</i> |

The co-operation and assistance of farmers, fruit growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the “Hatch Experiment Station, Amherst, Mass.”

The following bulletins are still in stock and can be furnished on demand : —

- No. 27. Tuberculosis in college herd; tuberculin in diagnosis; bovine rabies; poisoning by nitrate of soda.
- No. 33. Glossary of fodder terms.
- No. 35. Agricultural value of bone meal.
- No. 41. On the use of tuberculin (translated from Dr. Bang).
- No. 54. Fertilizer analyses.
- No. 55. Nematode worms.
- No. 57. Fertilizer analyses.
- No. 59. Fertilizer analyses.
- No. 63. Fertilizer analyses.
- No. 64. Analyses of concentrated feed stuffs.
- No. 67. Grass thrips; treatment for thrips in greenhouses.
- No. 68. Fertilizer analyses.
- No. 69. Rotting of greenhouse lettuce.
- No. 70. Fertilizer analyses.
- No. 71. Concentrated feed stuffs; condimental stock and poultry foods.
- No. 72. Summer forage crops.
- No. 73. Orchard experiments; fertilizers for fruits; thinning fruits; spraying fruits.
- No. 75. Fertilizer analyses.
- No. 76. The imported elm-leaf beetle.
- No. 77. Fertilizer analyses.
- Special bulletin, — The brown-tail moth.
- Special bulletin, — The coccid genera *Chionaspis* and *Hemichionaspis*.
- Index. 1888-95.

Of the other bulletins, a few copies remain, which can be supplied only to complete sets for libraries.

An outline of the more important work undertaken and the results secured is all the limits of our space will allow. From a series of experiments on the effect of feed on the compounds of milk and on the consistency of butter, particularly the effect of cotton-seed meal with a minimum amount of oil and likewise with the addition of cotton-seed oil on the relative properties of the several ingredients in milk and butter fat and on the body of the butter, the results seemed to be as follows : —

1. Cotton-seed meal with a minimum percentage of oil did not alter the percentage composition of the milk.

2. The addition of one-half to three-fourths of a pound of cotton-seed oil to the cotton-seed meal appeared to increase the fat percentage in the milk about .4 of 1 per cent. (5 to 5.4), and this increase was maintained during the six weeks of the feeding period.

3. The substitution of Cleveland flax meal for the cotton-seed meal and oil resulted in a decrease of the butter fat to about the percentage found in the first period, while the nitrogen percentage was increased. This change in composition was probably due to the removal of the cotton-seed oil from the ration, and not to the influence of the flax meal.

4. Cotton-seed meal with minimum oil caused no marked variation in the chemical composition of the butter fat.

5. The addition of cotton-seed oil to the cotton-seed meal ration produced a noticeable increase in the melting point and iodine number of butter fat.

6. Cotton-seed meal with a minimum oil produced a firm butter.

7. The addition of cotton-seed oil, while it increased the melting point of the butter fat, produced a softer, more yielding butter than that produced by either the cotton-seed meal or the standard ration.

8. An excess of cotton-seed oil in the ration is likely to affect the health of the animal.

Close attention was paid to the composition of concentrated feeds, and the farmers were warned of the following adulterations: cotton-seed meal mixed with fine ground hulls for genuine meal; finely ground corn-cobs for middlings in mixed feeds; finely ground rice hulls in the adulteration of standard grains; and oat offal instead of ground oats in mixing the so-called provender or cracked corn and ground oats.

In experiments with green crops, wheat and winter vetch were found preferable to winter rye for early forage; the chief value of barnyard millet was found to lie in its use as green fodder, by successive seedings using it until September. It was found to be not suitable for hay and taking the

place of corn for silage when impossible to secure a crop of corn. Experiments were also made in growing mixtures of legumes and non-legumes, in order to increase the amount of protein in the several forage crops, in the hope that the farmer would not require to purchase so much grain. Long-fellow corn and black cow peas were sown, yielding at the rate of 23 tons to the acre.

The entomological division has been chiefly occupied with the elm-leaf beetle; the brown-tail moth, which now covers an area of twelve hundred square miles, extending into Maine and New Hampshire; the gypsy moth, which, since the abandonment of the crusade against it, is now reappearing in the places from which it was surely being driven out; and the San José scale, which is now found in fifty-two localities in Massachusetts, and is attacking not only nurseries but all deciduous trees and shrubs. In one place, covering an area of five square miles, nearly every tree and shrub are affected. It would seem as if these four pests had come to stay, and three of them are spreading over the State with great rapidity. How to preserve our noble trees and fruitful orchards is the question that comes to all of us.

The botanical division has pursued its investigations in the sterilization of soil, examining into the various methods in use and the cost of the same. Desiccation or drying of the soil was found to increase the activity of the drop fungus, and on lettuce resulted in a stunted growth and an abnormally colored and worthless crop. The chrysanthemum rust, though very widely spread, is not considered of serious consequence, because it passes through only one stage, the uredo, and hence does not gain a strong foothold. The remedy seems to lie in selection of rust-free stock and inside cultivation, the latter being due to avoidance of mist and dew on the foliage, and therefore furnishing a less favorable opportunity for the spores to germinate and cause injury.

Three melon diseases have been recognized and studied, one a leaf blight, and two affecting both leaves and fruit. They have been particularly severe the past year, complaints coming from every part of the State. In general, the remedies seem to lie in maturing the crop as early as possible

by selecting early varieties or by transplanting, and spraying with Bordeaux mixture. The last mentioned is open to objection, from the difficulty of spraying both sides of the leaf.

Various stem rots, affecting the chrysanthemum, carnation and aster, have been the subject of careful investigation. These rots are produced by fungous growths clogging up the pores of the stem, and resulting in decay. In the aster the disease can be entirely averted by starting plants in the open ground, or otherwise avoiding "damping-off" conditions. In the chrysanthemum and carnation reliance is placed upon the use of hardy propagating stock and sterilized soil.

In the agricultural division the problems have been chiefly those connected with the nutrition of plants and the selection and use of fertilizers and manures. The results of the year's work seem to show (*a*) that sulfate of potash is superior to the muriate for clovers, while for cabbages the muriate is slightly superior; (*b*) that, used in connection with manures for garden crops, the sulfate of potash is better for early crops, while for late crops the muriate is of equal value; (*c*) that, in determining the relative value of phosphates applied on the basis of equal quantities of actual phosphoric acid, their relative standing was in the following order: raw bone, phosphatic slag, South Carolina rock, apatite, dissolved bone meal, dissolved bone-black, Tennessee phosphate, acid phosphate, steamed bone meal, Florida phosphate; (*d*) that, in a comparison of different varieties of ensilage corn, in the total yield they stood in the following order: Eureka, Boston Market, Rural Thoroughbred, Leaming Field, but in actual food value the Leaming Field, when ensiled, was superior; (*e*) that, in soil tests with grass, grass showed a marked dependence upon a liberal supply of fertilizer nitrogen and clover a still closer dependence upon a liberal supply of fertilizer potash; (*f*) that, in soil tests with onions, that crop showed a close dependence upon a liberal supply of potash, an abundant supply of lime for promoting the healthy growth of the crop and a liberal supply of readily available phosphate for

promoting the satisfactory ripening of the crop ; (g) that, on a moderately sloping field, it was found better to haul manure in the late autumn to large piles and spread and plough in the spring than to haul in the autumn and apply directly to the field, as the crops were increased more than enough to cover the extra cost of rehandling the manure. Growing alfalfa for a forage crop has proved quite unsuccessful, after a number of years' trial, the crop being exceedingly small. Mand's Wonder Foreign Crop, Brazilian millet and Pearl millet prove identical in every respect, and farmers are warned not to pay, under a new name, the high prices demanded for the old and well-known Pearl millet.

The details of the experiments thus briefly outlined may be found in the reports of the several divisions herewith submitted.

ANNUAL REPORT

OF GEORGE F. MILLS, *Treasurer* OF THE HATCH EXPERIMENT STATION
OF MASSACHUSETTS AGRICULTURAL COLLEGE,

For the Year ending June 30, 1901.

| | |
|---|-------------|
| Cash received from United States treasurer, | \$15,000 00 |
| Cash paid for salaries, | \$8,157 57 |
| for labor, | 2,941 04 |
| for publications, | 1,436 30 |
| for postage and stationery, | 269 33 |
| for freight and express, | 99 82 |
| for heat, light, water and power, | 259 63 |
| for seeds, plants and sundry supplies, | 621 30 |
| for fertilizers, | 182 21 |
| for feed stuffs, | 135 08 |
| for library, | 221 31 |
| for tools, implements and machinery, | 52 58 |
| for furniture and fixtures, | 75 59 |
| for scientific apparatus, | 5 49 |
| for live stock, | 20 25 |
| for travelling expenses, | 84 39 |
| for contingent expenses, | 147 52 |
| for building and repairs, | 290 59 |
| | <hr/> |
| | \$15,000 00 |
| Cash received from State treasurer, | \$11,200 00 |
| from fertilizer fees, | 3,490 25 |
| from farm products, | 2,091 08 |
| from miscellaneous sources, | 2,050 50 |
| | <hr/> |
| | \$18,831 83 |
| Cash paid for salaries, | \$11,099 76 |
| for labor, | 1,620 38 |
| for publications, | 681 28 |
| for postage and stationery, | 318 65 |
| for freight and express, | 102 49 |
| for heat, light, water and power, | 434 12 |
| | <hr/> |
| Amount carried forward, | \$14,256 68 |

| | | | | | |
|--|---|---|---|---|-------------|
| <i>Amount brought forward,</i> | . | . | . | . | \$14,256 68 |
| Cash paid for chemical supplies, | . | . | . | . | 534 45 |
| for seeds, plants and sundry supplies, | . | . | . | . | 428 27 |
| for fertilizers, | . | . | . | . | 510 88 |
| for feed stuffs, | . | . | . | . | 691 99 |
| for library, . | . | . | . | . | 130 38 |
| for tools, implements and machinery, | . | . | . | . | 122 28 |
| for furniture and fixtures, . | . | . | . | . | 22 25 |
| for scientific apparatus, . | . | . | . | . | 435 41 |
| for live stock, . | . | . | . | . | 318 00 |
| for travelling expenses, . | . | . | . | . | 663 12 |
| for building and repairs, . | . | . | . | . | 718 12 |
| | | | | | <hr/> |
| | | | | | \$18,831 83 |
| | | | | | <hr/> |

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the books and accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ending June 30, 1901; that I have found the books well kept and the accounts correctly classified as above; and that the receipts for the year are shown to be \$33,831.83 and the corresponding disbursements, \$33,831.83. All the proper vouchers are on file. These have been examined by me and have been found to be correct, there being no balance on accounts of the fiscal year ending June 30, 1901.

CHARLES A. GLEASON,

Auditor.

AMHERST, Aug. 1, 1901.

REPORT OF THE AGRICULTURISTS.

WM. P. BROOKS; ASSISTANT, H. M. THOMSON.

The work of the agricultural division of the experiment station for the past year has followed the general lines of investigation already undertaken. The problems chiefly engaging attention are those connected with the nutrition of plants and the selection and use of manures and fertilizers. These problems are of fundamental importance in the agriculture of the State; and, as our lines of inquiry are followed up from year to year, it is believed that little by little the results must contribute to the sum of our knowledge pertaining to many vital points.

It may possibly have been thought by some that, as comparatively few of our farmers yet use unmixed fertilizers, it can scarcely benefit them greatly to know the relative values of many of the materials dealt with in our experiments. This view is superficial, for, even though farmers may not yet largely employ chemicals, the manufacturers of mixed materials, always on the lookout for new light as to the needs of the various crops, are gradually modifying their goods in accordance with *well-established results of experiments*.

To cite one or two examples: one of the best-known brands of potato fertilizers, as made twelve years ago, had the following percentage composition: nitrogen, 4.12; soluble and available phosphoric acid, 7.59; total phosphoric acid, 12.17; potash, 5.23. As made last year, the same brand of fertilizer contained: nitrogen, 2.92; soluble and available phosphoric acid, 6.45; total phosphoric acid, 8.27; potash, 10. Twelve years ago most potato fertilizers contained potash in the form of muriate; they now very

generally contain this element in the form of sulfate. Such changes are in the interest of the farmers who use these fertilizers; and they are in line with suggestions based upon experiments here as well as in other stations.

The experiments with fertilizers are conducted in three distinct methods, — the plot method in the open field, the plunged cylinder method with equal weights of thoroughly mixed soil to the depth of four feet, and the pot method. The last two are valuable as checks on the results in the field, and in increasing the possible range and scope of inquiry. In our work in the field we have employed two hundred and twenty-two plots, we have one hundred and fifty-three of the cylinders in use, while in our pot experiments we have cared for two hundred and ninety-four pots.

The results of cylinder and pot experiments, being rather of scientific than of immediate practical interest, will not be presented in this report. Variety tests with corn and potatoes have engaged a considerable share of attention, but the varieties under trial have been tested but a single year, and results will not be reported. Our experiments with poultry have been directed, as in recent years, to a study of the best methods of feeding for eggs. The results, not being regarded as decisive and in some respects at variance with those of earlier years, will not be discussed in this report. This report, then, will deal only with the results of some of our more important plot experiments. The nature of the subjects of inquiry and the more salient features of our results will be made clear by the following statement: —

I. — To determine the relative value of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen. The crop of this year, soy beans, gives yields on the basis of which the materials rank in the following order: barnyard manure, nitrate of soda, dried blood, sulfate of ammonia. The average to date ranks the materials in the following order: nitrate of soda, barnyard manure, sulfate of ammonia, dried blood.

II. — To determine the relative value of muriate and high-grade sulfate of potash for field crops. Results of the year

indicate sulfate to be superior to the muriate for clovers ; for cabbages, the muriate proves slightly superior.

III. — *A.* To determine the relative value of nitrate of soda, sulfate of ammonia and dried blood, used in connection with manure as sources of nitrogen for garden crops. Results indicate these materials used in amounts furnishing equal nitrogen to rank in the following order : nitrate of soda, dried blood, sulfate of ammonia. *B.* To determine the relative value of sulfate of potash and muriate of potash, used in connection with manures for garden crops. Results of the year indicate the sulfate to be the better for early crops, while for late crops the muriate is equally good.

IV. — To determine the relative value of different phosphates used in equal money's worth. The results of the year rank the materials employed in the following order : phosphatic slag, South Carolina rock, Mona guano, dissolved bone-black, Florida rock phosphate.

V. — To determine the relative value of phosphates, applied on the basis of equal quantities of actual phosphoric acid. The relative standing of the several phosphates was in the following order : raw bone, phosphatic slag, South Carolina rock, apatite, dissolved bone meal, dissolved bone-black, Tennessee phosphate, acid phosphate, steamed bone meal, Florida phosphate.

VI. — To determine the relative value of different potash salts for field crops. The results of the year with wheat and corn are not very decisive, but indicate a high rate of availability for the new materials, — silicate and carbonate of potash.

VII. — Comparison of different varieties of ensilage corn. In total yield the varieties under trial rank in the following order : Eureka, Boston Market, Rural Thoroughbred, Leaming Field. In actual food value the Leaming Field when ensiled is superior.

VIII. — *A.* Soil test with grass. Results of the year indicate the close dependence of grass upon a liberal supply of fertilizer nitrogen, and the still closer dependence of clover upon a liberal supply of fertilizer potash. They also establish the possibility of raising profitable hay crops by

the use of fertilizers only, and indicate that in grass mixtures where clover is sown exceedingly profitable crops can be grown by the combination of a potash salt and an available phosphate. *B.* Soil test with onions. Results indicate the close dependence of this crop upon a liberal supply of potash, the vital importance of an abundant store of lime for the healthy growth of the crop, and of a liberal supply of readily available phosphate for promoting satisfactory ripening of the crop.

IX. — To determine the relative value for production of corn and grass in rotation of a large application of manure alone, as compared with a smaller application of manure with a moderate amount of potash salts. The crop of this year is mixed grass and clover. The result of the experiment was the production of nearly equal total weights of hay under the two systems, and hay of superior nutritive quality, because containing a larger proportion of clover, on the combined manure and potash.

X. — To determine the relative value for crop production of two fertilizer mixtures, one furnishing the important elements of plant food in the same proportions as in "special" corn fertilizers, the other furnishing less phosphoric acid and more potash, for corn and grass in rotation. The crop of this year is grass, and the mixture containing less phosphoric acid and more potash and costing the smaller sum per acre gives a larger yield both of hay and rowen, and in both cases of superior nutritive value on account of the large proportion of clover.

XI. — To determine the economic result of using in rotation on grass lands: the first year, ashes; the second, ground bone and muriate of potash; and the third, barnyard manure. The yields are large, amounting under these several systems of manuring to from rather over $3\frac{1}{4}$ to nearly $3\frac{3}{4}$ tons per acre. These yields are produced on a good margin of profit.

XII. — To determine whether the use of nitrate of soda for rowen is profitable. The results on an old sod consisting chiefly of Kentucky blue-grass is an increased rowen crop, resulting from the application of nitrate of soda at a

fair profit; on a Timothy sod the results on different plots vary widely, and the average is a small increase, produced at a cost greater than its value.

XIII. — To determine which is the better practice: to haul manure and spread directly on the field during late autumn or winter, or to haul at the same time to large piles in the field, to be spread and immediately ploughed in in the spring. The results indicate that on land sloping moderately the spring application is to be preferred, as the crops are more than sufficiently large to cover the extra cost of rehandling the manure.

XIV. — To determine the value of alfalfa as a forage crop for this locality. The results of a number of years are quite discouraging, as, with the most careful attention to tillage, manuring and keeping free from weeds, the crops are exceedingly small, — hardly one-half what might confidently be expected from clover under similar conditions.

XV. — To determine whether Mand's Wonder Forage Crop and Brazilian millet are different from Pearl millet. Results indicate that these three crops are identical in every respect, and that it will not pay farmers to give the high prices demanded for the old and long-known Pearl millet under a new name.

I. — THE RELATIVE VALUE OF MANURES FURNISHING NITROGEN. (FIELD A.)

A detailed description of the plan of experiment followed in this field will be found in the twelfth annual report. The materials under comparison are barnyard manure, nitrate of soda, sulfate of ammonia and dried blood. These wherever used are applied in such quantities as to furnish equal amounts of nitrogen. There are three plots in the field to which no nitrogen in any form has been applied. All the plots in the field receive the same amounts of phosphoric acid and potash. This experiment was begun in 1890, and the crops which have been grown previous to this year, in the order of succession, are: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover and potatoes. As

a result of all experiments previous to this year, it is found that the materials furnishing nitrogen have produced crops ranking in the following order : —

| | Per Cent. |
|--|-----------|
| Nitrate of soda, | 100 |
| Barnyard manure, | 90 |
| Sulfate of ammonia, | 89 |
| Dried blood, | 86 |
| The plots receiving no nitrogen, | 68 |

The crop for this year was soy beans. Growth was vigorous and healthy, the crop on all plots good. The yields are shown in the following table : —

Yield of Soy Beans per Acre.

| PLOTS. | Nitrogen Fertilizer. | Beans (Bushels). | Straw (Pounds). |
|--------------------|-----------------------------|---------------------|--------------------|
| Plot 0, | Barnyard manure, | 32.75 | 2,700 |
| Plot 1, | Nitrate of soda, | 31.55 | 2,750 |
| Plot 2, | Nitrate of soda, | 32.75 | 2,500 |
| Plot 3, | Dried blood, | 28.62 | 2,600 |
| Plot 4, | No nitrogen, | 28.97 | 2,600 |
| Plot 5, | Ammonium sulfate, | 28.10 | 2,300 |
| Plot 6, | Ammonium sulfate, | 31.03 | 3,050 |
| Plot 7, | No nitrogen, | 25.86 | 2,350 |
| Plot 8, | Ammonium sulfate, | 28.97 | 2,550 |
| Plot 9, | No nitrogen, | 27.93 | 2,200 |
| Plot 10, | Dried blood, | 33.28 | 2,600 |

The average results are as follows : —

| FERTILIZER. | Beans (Bushels). | Straw (Pounds). |
|---|---------------------|--------------------|
| Average of the no-nitrogen plots (3), | 27.59 | 2,386.7 |
| Nitrate of soda plots (2), | 32.15 | 2,650.0 |
| Dried blood plots (2), | 30.95 | 2,600.0 |
| Sulfate of ammonia plots (3), | 29.37 | 2,633.3 |

The relative standing of the different manures in the yield of grain is : —

| | Per Cent. |
|-------------------------------|-----------|
| Manure, | 100.0 |
| Nitrate of soda, | 98.1 |
| Dried blood, | 94.5 |
| Sulfate of ammonia, | 89.7 |
| No nitrogen, | 84.3 |

In yield of straw the rank is :—

| | Per Cent. |
|-------------------------------|-----------|
| Barnyard manure, | 100.0 |
| Nitrate of soda, | 98.1 |
| Sulfate of ammonia, | 97.5 |
| Dried blood, | 96.3 |
| No nitrogen, | 88.4 |

It will be seen that the different materials stand more nearly together this year than is the average of preceding years. The manure stands relatively higher than in former years, but the fertilizers stand in the same relative order, nitrate of soda proving the most efficient of the nitrogen fertilizers, and sulfate of ammonia the least as measured by grain production, while it is slightly ahead of the blood in the yield of straw. The comparatively even results of this year are doubtless to be accounted for chiefly by the fact that the crop of this season, the soy bean, is one capable of drawing upon the atmosphere for a considerable share of the nitrogen it requires. The development of nodules upon the roots of the crop this year was very abundant. In spite of this fact, it will be noticed that the crop on the no-nitrogen plots stands considerably below that on the other plots. It is, however, doubtless much more nearly on an equality with them than would have been the case with a crop not belonging to the clover family.

II. — THE RELATIVE VALUE OF MURIATE AND HIGH-GRADE SULFATE OF POTASH. (FIELD B.)

This experiment has been in progress since 1892. The object is to determine the relative value for different crops of the two leading potash salts, muriate and sulfate, when used in equal quantities continuously upon the same land. The field contains eleven plots, of one-eighth of an acre each. Six of these have been yearly manured with muriate

of potash and five with the high-grade sulfate of potash. These salts were used at the rate of 400 pounds per acre from 1892 to 1899 inclusive; in 1900 and 1901 the rate of application has been 250 pounds per acre. All plots receive yearly an application of fine-ground bone, at the rate of 600 pounds per acre. The crops grown in the field are rotated, and the following have been included: potatoes, field corn, sweet corn, grasses, oats and vetch, barley and vetch, winter rye, clovers of various kinds, sugar beets, soy beans and cabbages. The crops have been almost uniformly large. The results were summarized in the report of last year as follows:—

Among the crops grown, the potatoes, clovers, cabbages and soy beans have with very few exceptions done much the best on the sulfate of potash; while the yield of corn, grasses, oats, barley, vetches and sugar beets has been equally good on the muriate. The *quality* of the crops of potatoes and sugar beets produced on the sulfate of potash plots has been distinctly better than that of the crops produced on muriate of potash. Taking all the crops except the clovers into consideration, if we represent the efficiency of the high-grade sulfate of potash by the number 100 that of the muriate of potash is 98.1. Taking into account only those crops showing the preference for the sulfate of potash, and representing the efficiency of that salt by the number 100, the efficiency of the muriate of potash is 88.6.* The present difference in price between the two salts is only about \$5 per ton. The conclusion, therefore, appears to be warranted that, under conditions similar to those prevailing in this experiment, the selection of the sulfate rather than the muriate is wise.

The crops of the past year have been clovers of three kinds, and cabbages.

A. — Clovers (Sulfate v. Muriate of Potash).

The growth of the clover on the sulfate of potash was considerably better than on the muriate. The yields are shown below:—

* Clovers not included, because weeds have not been separated in harvesting.

Muriate v. High-grade Sulfate of Potash. — Clover Hay per Acre (Pounds).

| VARIETY. | Muriate of Potash. | High-grade Sulfate of Potash. |
|--|--------------------|-------------------------------|
| Common red clover, | 6,600 | 7,387.5 |
| Mammoth red clover, | 7,312 | 7,612.0 |
| Alsike clover (a portion weighed green), | 10,840 | 14,290.0 |

It should be stated, in commenting upon these results, that the crops, as in former years, were considerably mixed with weeds. The weights, however, while not affording an accurate basis of comparison for determination of the precise effects of the different potash salts on the clovers, are not misleading as to the nature of the effect. This is not magnified by the figures, but rather the reverse, for the reason that where the growth of the clover is less luxuriant the growth of the weeds is proportionally more so.

In this connection attention is called to the fact that two other plots in the field are now in clover which was sown in July. These plots have not been cut, but there is at the present time a great difference in favor of the sulfate of potash in the condition of the clover on the two plots.

In conclusion, concerning the merits of these two potash salts for clovers, it is believed that the sulfate is much the safer. Our experiments with these crops have extended over many years, and while sometimes the yield on the muriate of potash is as great as that on the sulfate, there have been many more instances when the yield on the sulfate has been much the better. The difference in favor of this salt appears to be greater in proportion as the rainfall is abundant. It seems probable that this fact is due to the greater loss of lime, which, in association with the acid of the muriate, is washed out of the soil in considerable quantities whenever climatic conditions favor soil leaching.

B. — Cabbages.

The crop of cabbages on both the potash salts used was good, at the rate per acre of 33,680 pounds on muriate of

potash and 30,600 pounds on sulfate. The yield on the muriate is somewhat better than on the sulfate, — a result which is at variance with results which have been obtained in some previous years. Clearly, climatic conditions have an important influence in determining the manurial effect of these salts.

III. — FERTILIZERS FOR GARDEN CROPS. (FIELD C.)

The experiments upon which the conclusions now presented are based have been in progress since 1891. Up to 1898, chemical fertilizers alone were used. During the past four years stable manure has been applied in equal quantities (at rate of 30 tons per acre) to each of the plots, while the chemical fertilizers have been used in the same amounts and applied to the same plots as at first. The crops grown during this series of years have included all important outdoor garden crops, viz., spinach, lettuce, onions, garden peas, table beets, early cabbages, late cabbages, potatoes, tomatoes, squashes, turnips, sweet corn and celery; and one small fruit, — strawberries. The experiments have been planned with reference to throwing light especially upon two points: —

A. — The relative value of nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen.

B. — The relative value of sulfate of potash and muriate of potash.

These two points will be separately discussed: —

A. — The Relative Value for Garden Crops of Nitrate of Soda, Sulfate of Ammonia and Dried Blood as Sources of Nitrogen.

The three fertilizers used as sources of nitrogen have from the first been applied in such amounts as to furnish equal nitrogen to each plot, and each fertilizer is always applied to the same plot. Each of the nitrogen fertilizers is used on two plots, — on one with sulfate of potash, on the other with muriate. Dissolved bone-black, as a source of phosphoric acid, is applied in equal quantities to all

plots. The results previous to this year were thus summarized in the last annual report:—

Taking into account the periods when chemical fertilizers only were used, and the crops (spinach, lettuce, onions, table beets, garden peas and early cabbages) whose period of growth is the comparatively early part of the season, we find the relative efficiency of the different materials used as the source of nitrogen:—

| | Per Cent. |
|-------------------------------|-----------|
| Nitrate of soda, | 100.0 |
| Dried blood, | 86.6 |
| Sulfate of ammonia, | 83.6 |

For the same periods, and taking into account those crops (tomatoes, garden beans and sweet corn) making much of their growth after hot weather fairly sets in, we find the relative standing as follows:—

| | Per Cent. |
|-------------------------------|-----------|
| Nitrate of soda, | 100.0 |
| Dried blood, | 97.8 |
| Sulfate of ammonia, | 103.5 |

For the period since manure has been applied, and taking into account the early crops only (spinach, lettuce, table beets, onions, garden peas and potatoes), the relative standing is:—

| | Per Cent. |
|-------------------------------|-----------|
| Nitrate of soda, | 100.0 |
| Dried blood, | 88.8 |
| Sulfate of ammonia, | 61.7 |

For the same period, taking into account the aggregate yield of all the late crops (tomatoes, cabbages, turnips, squashes and celery), the relative standing is:—

| | Per Cent. |
|-------------------------------|-----------|
| Nitrate of soda, | 100.0 |
| Dried blood, | 97.8 |
| Sulfate of ammonia, | 91.9 |

The crops for the past year have been onions, lettuce, table beets, late cabbages, garden peas, celery and English turnips (both as second crops) and strawberries. The average rates of yield per plot for each of the nitrogen fertilizers is shown in the following table:—

Nitrogen Fertilizers compared as Fertilizers for Garden Crops.
— Yield per Plot (Pounds).

| AVERAGE OF TWO PLOTS. | Onions. | Lettuce. | TABLE BEETS. | | Cabbages. | GARDEN PEAS. | | Strawberries. | TURNIPS. | | Celery. |
|--------------------------|---------|----------|-----------------|-------|-----------|-----------------|--------|---------------|----------|-------|---------|
| | | | Roots. | Tops. | | Peas. | Vines. | | Roots. | Tops. | |
| Nitrate of soda, . . . | 425.0 | 110.0 | 151.0 | 125 | 868.75 | 54.1 | 68.8 | 41.25 | 1,167.5 | 550.0 | 1,067.5 |
| Sulfate of ammonia, . . | 207.5 | 40.0 | 65.3 | 73 | 785.50 | 64.6 | 81.3 | 44.87 | 1,072.5 | 580.0 | 455.0 |
| Dried blood, | 365.0 | 97.5 | 136.0 | 115 | 915.50 | 55.8 | 67.5 | 75.46 | 1,102.5 | 627.5 | 945.0 |

It will be seen that for most of the crops the results are similar to the average results of preceding years. Combining the results of this year with those of previous years, the relative standing of the different fertilizers used as sources of nitrogen is as follows : —

For the early crops, *i.e.*, crops making most of their growth before mid-summer, including onions, lettuce, table beets, garden peas, and strawberries : —

| | |
|-------------------------------|-----------|
| | Per Cent. |
| Nitrate of soda, | 100.0 |
| Dried blood, | 92.7 |
| Sulfate of ammonia, | 54.8 |

For late crops, including cabbages, turnips and celery : —

| | |
|-------------------------------|-----------|
| | Per Cent. |
| Nitrate of soda, | 100.0 |
| Dried blood, | 98.7 |
| Sulfate of ammonia, | 77.5 |

The superiority of nitrate of soda as a source of nitrogen for most garden crops, indicated by the results of preceding years, is still further confirmed in the case of most of the crops by the results of this year. Nitrate of soda, among the various nitrogen fertilizers, furnishes a pound of nitrogen at present prices at lower cost than any other fertilizer which is fairly available. These facts make it evident that it should usually be selected, especially for early crops. Experiments here and elsewhere indicate that, if soil on which sulfate of ammonia is used is heavily limed, its rate of availability is much increased. The purchase and application of lime, however, adds to the cost of the

crop; and, even disregarding the lime, as the pound of actual nitrogen at current prices for sulfate of ammonia costs more than the same quantity at current prices for nitrate of soda, the latter is clearly economically preferable, if simply equally effective. We have found it more so.

B. — The Relative Value of Sulfate and Muriate of Potash for Garden Crops.

The history of the plots where these two potash salts are under comparison has been given under section A. The crops are of course the same as those which have been named under that section. Each potash salt is used on three plots, *i.e.*, with each of the three nitrogen fertilizers. The results of the past year are shown in the following table: —

Sulfate and Muriate of Potash compared as Fertilizers for Garden Crops. — Yield per Plot (Pounds).

| AVERAGE OF THREE PLOTS. | Onions. | Lettuce. | TABLE BEETS. | | Cabbages. | GARDEN PEAS. | | Strawberries. | TURNIPS. | | Celery. |
|--------------------------------|---------|----------|--------------|-------|-----------|--------------|--------|---------------|----------|-------|---------|
| | | | Roots. | Tops. | | Peas. | Vines. | | Roots. | Tops. | |
| Sulfate of potash, high grade. | 360 | 86.66 | 116.3 | 100.0 | 827.0 | 54.3 | 68.3 | 47.74 | 1,091.7 | 536.7 | 831.7 |
| Muriate of potash, . . . | 305 | 78.33 | 118.1 | 108.7 | 886.2 | 62.1 | 76.7 | 59.98 | 1,136.7 | 635.0 | 813.3 |

In commenting upon the results obtained in comparing these two fertilizers last year, the following tables were presented: —

Before Manure was used, — 1891-97.

| FERTILIZER. | Early Crops (Per Cent.). | Late Crops (Per Cent.). |
|------------------------------|--------------------------|-------------------------|
| Sulfate of potash, | 100.0 | 100.0 |
| Muriate of potash, | 91.3 | 91.5 |

After Manure was used, — 1898-1900.

| FERTILIZER. | Early Crops (Per Cent.). | Late Crops (Per Cent.). |
|------------------------------|--------------------------|-------------------------|
| Sulfate of potash, | 100.0 | 100.0 |
| Muriate of potash, | 86.1 | 98.8 |

Including the crops of the past year, the standing is shown below; under the headings early and late crops respectively are included those specified in section A: —

| FERTILIZER. | Early Crops (Per Cent.). | Late Crops (Per Cent.). |
|------------------------------|-----------------------------|----------------------------|
| Sulfate of potash, | 100.0 | 100.0 |
| Muriate of potash, | 92.6 | 103.0 |

It will be noticed that for the early crops the sulfate of potash is superior to the muriate, while for the late crops, including those of this year, muriate stands slightly ahead. This has not been the case in earlier years, but the nature of the difference has always been the same. The sulfate should undoubtedly be preferred for early crops, unless the soil is heavily limed, in which case results here and in many other places indicate that the muriate may answer equally well.

IV. — THE RELATIVE VALUE OF DIFFERENT PHOSPHATES. (FIELD F.)

The object of this experiment is to determine whether it is more profitable to employ cheaper natural phosphates, or one of the higher priced dissolved phosphates. The articles compared are dissolved bone-black, ground South Carolina rock, ground Florida rock, Mona guano and phosphatic slag. These phosphates were applied during the years 1890 to 1893, on the basis of equal money's worth. The amounts of phosphoric acid supplied to the several plots on this basis have of course varied widely, as the prices of the materials differ greatly. The actual amounts of phosphoric acid supplied the several plots are as follows: —

| PLOTS. | Fertilizer. | Pounds. |
|-------------------|--|---------|
| Plot 1, | Phosphatic slag, | 96.72 |
| Plot 2, | Mona guano, | 72.04 |
| Plot 3, | Ground Florida rock phosphate, | 165.70 |
| Plot 4, | Ground South Carolina rock, | 144.48 |
| Plot 5, | Dissolved bone-black, | 45.36 |

Since 1893 no phosphate has been applied to any part of the field. The object in view in withholding phosphates has been to test the lasting qualities of the several materials. At the beginning of the present season, supposing the crops harvested to have been of average composition, and that there has been no loss of phosphoric acid by leaching (which is improbable), there must have remained of the total phosphoric acid applied to the several plots the following amounts in each : —

| | Pounds. |
|--|---------|
| Phosphatic slag, | 53.6 |
| Mona guano, | 29.7 |
| Florida phosphate, | 132.4 |
| South Carolina rock phosphate, | 102.0 |
| Dissolved bone-black, | 9.5 |

Throughout the entire period of the experiment (1890 to date), materials supplying nitrogen and potash have been applied in equal amounts to all plots. Since 1893 the quantities applied have been made very large, in order to make it certain that the crops grown may find in the soil all the nitrogen and potash they can possibly need. All the plots in the field were limed at the rate of one ton to the acre of quick-lime, slaked, spread after ploughing and deeply worked in with a harrow in the spring of 1898. The crops which have been raised on the field previous to this year, in the order of their succession, are potatoes, wheat, serradella, corn, barley, rye, soy beans, Swedish turnips, corn, oats and cabbages. Representing the yield on the plot giving the highest returns by 100, the relative efficiency* of the different phosphates at the beginning of this year stood as follows : —

| | Per Cent. |
|---------------------------------------|-----------|
| Phosphatic slag, | 100.0 |
| Ground South Carolina rock, | 92.3 |
| Dissolved bone-black, | 90.7 |
| Mona guano, | 88.3 |
| Florida phosphate, | 71.5 |

Taking into account the crops grown since 1895, when for the first time a plot to which no phosphate was applied was included, the phosphates have the following relative rank :* —

* Swedish turnips, grown in 1897, have not been included in computing these percentages as that crop was affected by disease not apparently connected with the fertilizers used.

| | Per Cent. |
|---------------------------------------|-----------|
| Ground South Carolina rock, | 100.0 |
| Phosphatic slag, | 99.0 |
| Dissolved bone-black, | 97.7 |
| Mona guano, | 95.4 |
| Florida phosphate, | 64.2 |
| No phosphate, | 55.4 |

The crop this year has been oats, of the Early Race-horse variety. The soil was well prepared, the crop sown May 6. The growth was, so far as could be seen, unaffected by accidental conditions. There were, however, more weeds on plots 3 and 4 than elsewhere; and, as it was impossible to separate these completely in handling the crop, some of them were weighed with the straw. The figures representing weights of straw for these plots, especially for plot 3, on which weeds were most abundant, are therefore without doubt to some extent misleading. The several plots produced yields at the following rates per acre :—

Comparison of Phosphates. — Yield of Oats per Acre.

| PLOTS. | Fertilizer. | Grain (Bushels). | Straw (Pounds). |
|-------------------|---------------------------------------|---------------------|--------------------|
| Plot 0, | No phosphate, | 18.24 | 365 |
| Plot 1, | Phosphatic slag, | 21.00 | 1,208 |
| Plot 2, | Mona guano, | 17.59 | 1,059 |
| Plot 3, | Ground Florida rock, | 13.98 | 1,447 |
| Plot 4, | Ground South Carolina rock, | 19.96 | 1,201 |
| Plot 5, | Dissolved bone-black, | 16.63 | 1,058 |

Representing the yield of grain on plot 1 by the number 100, the relative standing of the other plots is shown by the following table :—

| PLOTS. | Fertilizer. | Per Cent. |
|-------------------|---------------------------------------|-----------|
| Plot 0, | No phosphate, | 86.8 |
| Plot 1, | Phosphatic slag, | 100.0 |
| Plot 2, | Mona guano, | 83.8 |
| Plot 3, | Ground Florida rock, | 66.6 |
| Plot 4, | Ground South Carolina rock, | 95.0 |
| Plot 5, | Dissolved bone-black, | 79.2 |

The plots which stand highest this year are the same as those standing highest in the general averages which have been shown above, viz., the ones receiving phosphatic slag and ground South Carolina rock phosphate. The low standing of the plot which received Florida phosphate is, as in former years, very striking; it stands this year below the no-phosphate plot. It should be remembered, however, that the latter has not been included in this experiment as long as the Florida phosphate plot; and it may well be that the original store of phosphoric acid in the soil of the no-phosphate plot is to a much less degree exhausted than is the case on the other plots. It must be concluded that the phosphoric acid supplied by the Florida phosphate is in a form of combination rendering it exceedingly unavailable.

In the writer's opinion, the oat crop is a much less certain indicator as to the condition of the soil as regards available phosphoric acid than are the crops belonging to the cabbage and turnip family. This is indicated by the fact that the differences in yields with oats this year are much less than were the differences with turnips and cabbages. As the turnips, as already stated, were badly affected by disease, figures for this crop are not presented. The relative yields with cabbages last year were as follows:—

| | Per Cent. |
|--|-----------|
| South Carolina rock phosphate, | 100.0 |
| Dissolved bone-black, | 73.0 |
| Phosphatic slag, | 60.0 |
| Mona guano, | 55.3 |
| Florida rock phosphate, | 14.7 |
| No phosphate, | 6.9 |

It should be noticed that the relative position of the several phosphates is nearly the same as this year, but the differences are far greater.

In conclusion, attention is called to the fact that the crops on this field in recent years have not been satisfactory in amount, even on the best plot. The fact that no phosphoric acid in any form has been applied during the last nine years sufficiently accounts for the relatively small yields. Our results, however, indicate a relatively high degree of availability for the phosphoric acid contained in the South Carolina rock and in phosphatic slag. There can

be no doubt that profitable crops of most kinds can be produced by liberal use of these natural phosphates; and in a long series of years there would be a considerable money saving in depending, at least in part, upon these rather than upon the higher-priced dissolved phosphates. It may, however, be doubted whether, under the conditions prevailing in ordinary farm or garden practice, it is ever wise to depend exclusively upon the natural phosphates. The best practice would probably be found to consist in using one of these in part, and in connection with it a moderate quantity of one of the dissolved phosphates.

V. — THE COMPARISON OF PHOSPHATES ON THE BASIS OF EQUAL APPLICATION OF PHOSPHORIC ACID.

The phosphates under comparison on this basis include apatite, South Carolina rock phosphate, Florida soft phosphate, phosphatic slag, Tennessee phosphate, dissolved bone-black, raw bone, dissolved bone, steamed bone and acid phosphate. The experiments have been in progress five years, each phosphate being applied yearly to the same plot. There are three no-phosphate plots, which serve as a basis for comparison. The plots are one-eighth of an acre each in area.

The phosphates yearly applied are used in quantities sufficient to furnish actual phosphoric acid at the rate of 96 pounds to the acre. All plots are manured alike with materials furnishing nitrogen and potash in available forms and in equal amounts to each. The materials used furnish nitrogen at the rate of 52 pounds and potash at the rate of 152 pounds per acre. The preceding crops have been: corn, cabbages, corn, and in 1900 oats for hay, and Hungarian grass, also cut for hay. The yields of all these crops have been large, even on the three plots in the field which received no phosphate. The results have been rendered somewhat obscure by the natural variation in the productiveness of the plots in different parts of the field. Plot 1, which receives no phosphoric acid, is naturally much more fertile than any other plot in the field, and in estimating the significance of the results this plot should be

disregarded. The crop for the present year has been onions. As has been the case throughout this part of the State, the onion crop suffered from blight. Our yields of sound and merchantable onions are therefore comparatively small. The results are shown in the table : —

Onions on Plots manured with Equal Amounts of Phosphoric Acid.

| Plots. | Fertilizer. | Onions (Bushels per Acre). | Scallions (Pounds per Acre). |
|----------------|------------------------------------|----------------------------------|------------------------------------|
| Plot 1, . . . | No phosphate, | 278.5 | 1,280 |
| Plot 2, . . . | Apatite, | 222.3 | 1,840 |
| Plot 3, . . . | South Carolina rock phosphate, . . | 235.4 | 1,800 |
| Plot 4, . . . | Florida soft phosphate, | 150.6 | 2,280 |
| Plot 5, . . . | Phosphatic slag, | 251.8 | 1,160 |
| Plot 6, . . . | Tennessee phosphate, | 205.7 | 1,720 |
| Plot 7, . . . | No phosphate, | 141.4 | 2,000 |
| Plot 8, . . . | Dissolved bone-black, | 209.5 | 600 |
| Plot 9, . . . | Raw bone, | 252.3 | 640 |
| Plot 10, . . . | Dissolved bone meal, | 213.2 | 600 |
| Plot 11, . . . | Steamed bone meal, | 187.8 | 560 |
| Plot 12, . . . | Acid phosphate, | 187.8 | 920 |
| Plot 13, . . . | No phosphate, | 123.4 | 1,800 |

The conclusions stated last year were as follows : —

1. The phosphatic slag evidently furnished phosphoric acid in an exceedingly available form, the yield this year being almost equal to that on the dissolved bone-black.

2. The Florida soft phosphate is apparently a very inferior material, the phosphoric acid evidently becoming available only with great slowness.

3. Steamed bone meal appears to be inferior in availability to raw bone meal.

The results of this year are in most particulars similar. Phosphatic slag, it is true, is exceeded, by a small fraction of a bushel of merchantable onions, by raw bone meal, but it gives a larger total crop. Dissolved bone-black stands relatively lower than last year. Raw bone meal, as last year, is superior to steamed bone meal. The Florida soft

phosphate gives a very inferior crop, — the poorest, indeed, in merchantable onions of any phosphate used. This result is strikingly confirmatory of the results obtained in the field where phosphates are under comparison on the basis of equal money's worth.

VI. — COMPARISON OF DIFFERENT POTASH SALTS FOR FIELD CROPS. (FIELD G.)

Since 1898 the following potash salts have been under comparison for various field crops: kainite, high-grade sulfate, low-grade sulfate, muriate, nitrate, carbonate and silicate. Each is applied annually to the same plot, and all are used in such quantities as to furnish equal potash to each plot. All plots are equally manured with materials furnishing nitrogen and phosphoric acid. There are forty plots, in five series of eight plots each, each series including a no-potash plot and one for each potash salt used. The area per plot is about one-fortieth of an acre. The crops the present year have been wheat on one series of eight plots, and corn of four different varieties on the other four series.

A. — *Wheat.*

The variety of wheat was the Turkish Red Winter, seed of which was received from the United States Department of Agriculture. The soil is rather heavy, and the seed was received so late that it was got in somewhat later than desirable, viz., October 13. It was sown broadcast at the rate of five pecks to the acre, and covered with the Acme harrow. Owing no doubt chiefly to the lateness of sowing, there was some winter-killing. This was most severe on the no-potash, kainite and the two sulfate plots. The whole field was harrowed about the middle of May. The growth was unusually healthy for this section, although all plots were slightly affected by rust. The grain was plump, hard and of good quality. The yields were as follows: —

Wheat. — Yield per Acre.

| PLOTS. | Potash Salt. | Grain (Bushels). | Straw (Pounds). |
|-----------------|-----------------------------------|---------------------|--------------------|
| Plot 1, | No potash, | 8.19 | 1,609 |
| Plot 2, | Kainite, | 10.43 | 1,475 |
| Plot 3, | High-grade sulfate of potash, . . | 14.15 | 1,877 |
| Plot 4, | Low-grade sulfate of potash, . . | 14.15 | 2,595 |
| Plot 5, | Muriate of potash, | 15.64 | 1,877 |
| Plot 6, | Nitrate of potash, | 16.38 | 3,083 |
| Plot 7, | Carbonate of potash, | 14.89 | 2,458 |
| Plot 8, | Silicate of potash, | 17.13 | 2,055 |

B. — Corn.

As already stated, the corn was of four varieties. These varieties were as follows: Eureka, a large dent corn, seed obtained from Ross Bros.; Boston Market Ensilage, a large dent variety, seed obtained from Joseph Breck & Sons; Leaning Field, a moderately large dent variety, seed obtained from Gregory; Rural Thoroughbred, a large and late white flint variety, seed obtained from Landreth. All varieties were planted June 6. The field was given good care throughout the season, growth was normal and healthy, unaffected by accidental conditions which influenced results, though all varieties were somewhat broken down by a storm which occurred on September 11. The corn was cut September 13 and 14, and weighed within twenty-four hours. The average for the several fertilizers was as follows:—

Corn. — Average Yield of Four Varieties.

| POTASH SALT. | Pounds per Acre. |
|---|---------------------|
| No potash, | 37,810 |
| Kainite, | 40,610 |
| High-grade sulfate of potash, | 37,530 |
| Low-grade sulfate of potash, | 39,375 |
| Muriate of potash, | 40,490 |
| Nitrate of potash, | 40,435 |
| Carbonate of potash, | 40,155 |
| Silicate of potash, | 39,240 |

The only feature of the results to which especial attention is called is the comparatively large yields obtained on the muriate and nitrate, and the good yields on the compara-

tively new fertilizers, carbonate and silicate, which it would seem must possess a high degree of availability.

VII. — VARIETIES OF ENSILAGE CORN COMPARED.

The varieties of ensilage corn used in the comparison of potash salts, viz., Eureka, Boston Market, Leaming Field and Rural Thoroughbred, were grown under conditions which make it possible to compare them accurately the one with the other; and this comparison seems worth while, on account of the diversity in the practice of farmers, many of whom cultivate excessively large and late varieties of ensilage corn, on account of the heavy yields obtained. The aggregate yield of the varieties under trial was at the following rates per acre:—

| | Pounds. |
|-------------------------------|---------|
| Eureka, | 47,960 |
| Boston Market, | 38,200 |
| Leaming Field, | 34,520 |
| Rural Thoroughbred, | 36,150 |

The following notes were taken on the several varieties just previous to harvest:—

Eureka: a late dent; average height, about 15 feet; very heavily leaved; stalks, $1\frac{3}{4}$ to 2 inches in diameter; ears just forming.

Boston Market: late dent; height, 11 to 12 feet; stalks, $1\frac{1}{2}$ to $1\frac{3}{4}$ inches in diameter; ears large, roasting stage; leaves quite abundant.

Leaming Field: medium dent; average height, 10 feet; leaves comparatively few; stalks medium; ears large, beginning to dent; the earliest of the four varieties.

Rural Thoroughbred: late white flint; average height, about 10 feet; stalks large, many $1\frac{1}{4}$ inches in diameter; heavily leaved; a few suckers (these increase weight but little, and are troublesome to handle); ears large, heavy, often two per stalk; not quite in milk.

The Eureka, giving the best yield, at the rate of almost 24 tons to the acre, would be preferred by many farmers, but in view of the results of analyses it seems doubtful whether this preference is justified by the facts. The table shows the total food substance per acre afforded by each of the varieties:—

Field G. — Varieties of Ensilage Corn, Food Substance per Acre (Pounds).

| VARIETY. | Dry Matter. | Ash. | Protein. | Crude Fibre. | Nitrogen-free Extract Matter. | Fat. |
|-------------------------------|-------------|-------|----------|--------------|-------------------------------|-------|
| Eureka, | 8,944 | 468.7 | 613.5 | 2,951.0 | 4,790.0 | 120.8 |
| Boston Market, | 6,864 | 369.3 | 505.9 | 2,183.0 | 3,701.0 | 104.3 |
| Leaming Field, | 7,524 | 343.9 | 616.2 | 1,839.5 | 4,547.0 | 176.8 |
| Rural Thoroughbred, | 7,923 | 423.1 | 626.7 | 2,140.0 | 4,614.0 | 118.8 |

Examination of the table shows that the variety giving the heaviest yield (green weight) also furnishes the greatest number of pounds total dry matter; but when we compare the figures of the other columns in the table, it will be seen that this excess of dry matter is made up entirely of fibre and nitrogen-free extract, which are the least valuable constituents. In total yield of protein (the most valuable constituent) the Eureka is exceeded by two varieties, — Leaming Field and Rural Thoroughbred; in yield of fat it is much exceeded by the Leaming Field. It would seem the last-named variety, though giving the smallest yield, should be preferred. One pound of digestible fat is commonly considered to have a food value equal to two and one-half pounds of digestible fibre, or extract matter. Fat is commonly equally as digestible as nitrogen-free extract, and is less affected by the fermentations which go on in the silo than are the starches and sugar (extract matter). It is more digestible than fibre. In corn which is approaching maturity the proportion of starch is comparatively high; this food substance is at that time abundantly stored in the grain. As corn approaches maturity, while the starch increases, the proportion of sugar in the juice of the plant decreases. Sugar in green corn fodder is a valuable food substance, but in the silo the sugar is largely converted into acid, and acid has no food value. Starch, while it may suffer some loss in the silo, is far less affected than is sugar. Other things being equal, the immature corn will make, under average silo conditions, a more acid silage than corn which is nearer ripe. The large proportion of water in immature corn, as well as the relatively large amount of sugar, favor develop-

ment of acid. Silage from immature corn, then, is likely to be excessively sour, and is for that reason less desirable than silage from more mature corn.

The chief points, then, which may be urged against the selection of excessively late varieties of corn for ensilage, are as follows : —

1. Much greater bulk and water in proportion to actual food value.

2. Greater probable waste in the manger, on account of the refusal of the animals to eat the very thick and coarse stalks.

3. Such corn, while furnishing more dry matter, contains in larger proportion the less valuable food substances (fibre and sugar) and a smaller proportion of protein, fat, and (though not proved by our analyses) we may safely say starch as well.

4. The immature corn produces a very sour silage, on account of the relatively large proportion of sugar and of water.

5. Though this point is not always important, grass and clover are apt to make but a poor start when seeded in fields planted with excessively large and late varieties. As a large proportion of farmers in some sections now usually seed in ensilage corn, this point should not be disregarded.

VIII. — SOIL TESTS.

During the past season two soil tests have been carried out on our own grounds, both in continuation of previous work upon the same fields. The same kinds of fertilizers have been applied to each plot, and in the same amounts as last year. The fertilizers in these experiments are used in accordance with the co-operative plan for soil tests adopted in Washington in 1889. Each fertilizer, wherever employed, is applied at the same rates per acre. The following table shows the kinds and usual amounts : —

Nitrate of soda, 160 pounds, furnishing nitrogen.

Dissolved bone-black, 320 pounds, furnishing phosphoric acid.

Muriate of potash, 160 pounds, furnishing potash.

Land plaster, 400 pounds.

Lime, 400 pounds.

Manure, 5 cords.

A. — Soil Test with Grass. (South Acre.)

This acre has been used in soil tests for thirteen years, beginning in 1889. The crops in successive years have been as follows: corn, corn, oats, grass and clover, grass and clover, corn, followed by mustard as a catch-crop, rye, soy beans, white mustard, corn, corn, and grass and clover in 1900. The field has not been ploughed this year but received fertilizers as usual. During the entire thirteen years four of the fourteen plots have received neither manure nor fertilizer; three plots have received yearly a single important manurial element, viz., one of them nitrogen, another phosphoric acid and another potash, — every year the same; three have received each year two of these elements; one has received all three yearly; and one each has yearly lime, plaster or manure. Much of the field, having been either entirely unmanured or supplied with only a portion of the elements ordinarily considered as essential, is now much exhausted. The four nothing plots this year produced an average yield of 375 pounds of hay to the acre at the first cut and 313 pounds at the second cut. The table shows the rate of yield of the several plots:—

Hay and Rowen. — South Acre Soil Test, 1901.

| Plots. | FERTILIZERS USED. | YIELD PER ACRE (POUNDS). | | GAIN OR LOSS PER ACRE, COMPARED WITH NOTHING PLOTS (POUNDS). | |
|--------|--|-----------------------------|--------|--|-----------|
| | | Hay. | Rowen. | Hay. | Rowen. |
| 1 | Nitrate of soda, | 900 | 550 | +500 | +310 |
| 2 | Dissolved bone-black, | 300 | 370 | —100 | +130 |
| 3 | Nothing, | 400 | 240 | — | — |
| 4 | Muriate of potash, | 600 | 700 | +233.33 | +450 |
| 5 | Lime, | 500 | 360 | +166.67 | +100 |
| 6 | Nothing, | 300 | 270 | — | — |
| 7 | Manure, | 3,600 | 2,700 | +3,300 | +2,340 |
| 8 | Nitrate of soda and dissolved bone-black. | 1,200 | 530 | +800 | +170 |
| 9 | Nothing, | 400 | 360 | — | — |
| 10 | Nitrate of soda and muriate of potash, | 2,100 | 900 | +1,700 | +533.50 |
| 11 | Dissolved bone-black and muriate of potash. | 1,900 | 1,500 | +1,500 | +1,126.67 |
| 12 | Nothing, | 400 | 380 | — | — |
| 13 | Plaster, | 200 | 200 | —200 | —180 |
| 14 | Nitrate of soda, dissolved bone-black and muriate of potash. | 3,300 | 1,100 | +2,900 | +720 |

The effect of each of the three elements of plant food — nitrogen, phosphoric acid and potash — is more clearly brought out in the tables which follow : —

| | RESULTS OF THE ADDITION OF NITROGEN TO— | | | | |
|----------------------------|---|-----------------------|--------------------|----------------------------------|-----------------|
| | Nothing. | Dissolved Bone-black. | Muriate of Potash. | Dissolved Bone-black and Potash. | Average Result. |
| Hay (pounds per acre), . | +500 | +900 | +1,466.67 | +1,400 | +1,066.67 |
| Rowen (pounds per acre), . | +310 | +40 | +83.33 | —406.67 | +26.67 |

Value of increase, \$8 59
 Financial result (gain), 5 39

| | RESULTS OF THE ADDITION OF PHOSPHORIC ACID TO— | | | | |
|----------------------------|--|------------------|--------------------|---------------------|-----------------|
| | Nothing. | Nitrate of Soda. | Muriate of Potash. | Nitrate and Potash. | Average Result. |
| Hay (pounds per acre), . | —100 | +300 | +1,266.67 | +1,200 | +666.67 |
| Rowen (pounds per acre), . | +130 | —140 | +676.67 | +186.67 | +213.33 |

Value of increase, \$7 04
 Financial result (gain), 3 84

| | RESULTS OF THE ADDITION OF POTASH TO— | | | | |
|----------------------------|---------------------------------------|------------------|-----------------------|-----------------------------------|-----------------|
| | Nothing. | Nitrate of Soda. | Dissolved bone-black. | Nitrate and Dissolved Bone-black. | Average Result. |
| Hay (pounds per acre), . | +233.33 | +1,200 | +1,600 | +2,100 | +1,283.33 |
| Rowen (pounds per acre), . | +450 | +233.33 | +996.67 | +550 | +555 |

Value of increase, \$14 71
 Financial result (gain), 11 51

| | RESULTS OF THE ADDITION TO NOTHING OF— | | | |
|--------------------------------|--|----------------------|----------|---------|
| | Manure. | Complete Fertilizer. | Plaster. | Lime. |
| Hay (pounds per acre), . . . | +3,300 | +2,900 | —200 | +166.67 |
| Rowen (pounds per acre), . . . | +2,430 | +720 | —180 | +100 |
| Value of increment, | \$45 84 | \$28 96 | — | \$2 12 |
| Value of decrease, | — | — | \$3.04 | — |
| Financial result, | \$20 84* | \$19 36* | \$4 84† | \$0 92* |

* Gain.

† Loss.

It will be noticed that the employment of nitrate of soda alone results in a considerable increase both in the first and second cuttings, but its effect in increasing the crop is comparatively small here, no doubt because the soil of that plot must be quite deficient in both phosphoric acid and potash. It will be noticed that the increase produced by the nitrate of soda is greater where it is used with other fertilizers. It gives the greatest increase where used with potash alone, though much the best crop is secured where it is used in combination with both potash and dissolved bone-black. The effect of the dissolved bone-black when used alone amounts to nothing; when combined with potash, or with both nitrate and potash, it appears to be very useful. This is undoubtedly due to the fact that its presence is favorable to the growth of clover, which, as will be seen from the tables below, is very abundant on those plots where bone-black and potash are used together. The ability of clover to thrive in the presence of suitable amounts of bone-black, potash and lime is well known. The crops on the plot where the dissolved bone-black and potash have been so long used, and without any addition of either manure or fertilizer which furnishes nitrogen during the entire thirteen years, afford a striking object lesson. Here we have a yield at the rate of 1,900 pounds of hay to the acre in the first crop and 1,500 pounds in the second. Such crops are far above the average under much more expensive systems of manuring. They are accounted for by the capacity which clover grown under such soil conditions as must exist on this plot possesses to draw the needed nitrogen from the air. It will be noticed that the potash alone gives but a moderate crop, but when used in combination with either of the other fertilizers or with both of them the result is a large increase. As will be seen from the table below, the plots where the potash is used are characterized by relatively large percentages of clover, while there is no clover on the plots to which no potash has been applied. Especially striking is the large increase in the rowen crop where potash is used in connection with dissolved bone-black,—an increase due almost

entirely to the large percentage of clover found on that plot. Attention is further called to the fact that the first cutting of hay on the plot receiving nitrate, dissolved bone-black and potash is almost equal to that on the plot which has yearly received a dressing of barnyard manure at the rate of 5 cords per acre.

The analysis of the manure used is shown below : —

| | Per Cent. |
|----------------------------------|-----------|
| Water, | 66.61 |
| Total phosphoric acid, | .40 |
| Potash, | .61 |
| Nitrogen, | .52 |

At the rate at which it was applied, the manure supplied, per plot : nitrogen, 4.86 pounds ; phosphoric acid, 3.74 pounds ; potash, 5.70 pounds. The fertilizers used on plot 14 supplied : nitrogen, about 1.2 pounds ; phosphoric acid, about 1.6 pounds ; potash, 4.0 pounds.

As was stated in the last annual report, this field was seeded with mixed grass and clover seeds. The clover soon disappeared from all except those plots to which potash has been yearly applied. In order more clearly to show the relation of the fertilizers to the growth of the clover, the product of an average square yard was carefully cut in June and separated into three parts in each case, viz., grass, clover and weeds (including all plants other than true grasses and clover). The material thus secured was allowed to dry until November 16. It was then weighed, with results shown below : —

Effect of Fertilizer on Proportion of Clover. — Product of One Square Yard, Air Dry.

| | No Fertilizer. | Nitrate of Soda. | Dissolved Bone-black. | Muriate of Potash. | Nitrate and Dissolved Bone-black. | Nitrate and Muriate of Potash. | Dissolved Bone-black and Muriate of Potash. | Nitrate, Dissolved Bone-black and Muriate of Potash. |
|---------------------------------|----------------|------------------|-----------------------|--------------------|-----------------------------------|--------------------------------|---|--|
| Grass (grams), | 28.7 | 84.2 | 22.6 | 49.80 | 74.5 | 76.5 | 131.5 | 133.5 |
| Clover (grams), | - | - | - | 30.50 | - | 45.0 | 108.0 | 75.5 |
| Weeds (grams), | - | 2.8 | - | - | - | - | - | - |
| Percentage of clover, | - | - | - | 37.98 | - | 37.0 | 45.1 | 36.1 |

When it is remembered that the clover seed which was sown in large quantities came up abundantly upon all plots, it is surely striking that it should have entirely disappeared from every plot except those on which the potash fertilizers have been applied.

B. — Soil Test with Onions (North Acre).

This experiment was conducted upon land which has been used twelve years in soil test work. Each year each plot in the field has been manured in the same manner. The last four crops have been onions, and during the time that the field has been used in experiments with onions it has received double the quantities of fertilizers usually used in soil tests; viz., for each fertilizer, wherever it is used, at the following rates per acre: nitrate of soda, 320 pounds; dissolved bone-black, 640 pounds; muriate of potash, 320 pounds. The plots in this field are long and narrow, about 210 feet by 101½ feet. One-half of each plot was limed in the spring of 1899 at the rate of one ton per acre of quick-lime, slaked, spread evenly after ploughing and harrowed in. The crops grown in this field previous to the onions, in the order in which they have been raised, are: potatoes, corn, soy beans, oats, grass and clover, grass and clover, cabbages and rutabaga turnips, and potatoes. The variety of onions grown this year was Danvers Yellow Globe. The seed germinated well; but the plants on most of the plots made little growth, and many soon died, especially on the unlimed portions of plots which had received an application of muriate of potash, or nitrate of soda, or a combination of these without bone-black. The following tables show the results, bulbs and tops being weighed together:—

Onions. — North Acre Soil Test, 1901.

| Plots. | FERTILIZERS USED. | YIELDS PER ACRE OF BULBS AND TOPS (POUNDS). | | GAIN OR LOSS PER ACRE, COMPARED WITH NOTHING PLOTS (POUNDS). | |
|--------|--|---|--------|---|-----------|
| | | Unlimed. | Limed. | Unlimed. | Limed. |
| 1 | Nothing, | 1,680 | 3,200 | - | - |
| 2 | Nitrate of soda, | 2,400 | 4,200 | +813.33 | +1,333.33 |
| 3 | Dissolved bone-black, . . | 1,880 | 2,600 | +386.67 | +66.67 |
| 4 | Nothing, | 1,400 | 2,200 | - | - |
| 5 | Muriate of potash, | 3,000 | 11,200 | +1,750 | +8,930 |
| 6 | Nitrate of soda and dissolved bone-black. | 8,800 | 8,000 | +7,700 | +5,660 |
| 7 | Nitrate of soda and muriate of potash. | 2,400 | 13,800 | +1,450 | +11,390 |
| 8 | Nothing, | 800 | 2,480 | - | - |
| 9 | Dissolved bone-black and muri- ate of potash. | 10,000 | 13,200 | +9,050 | +10,660 |
| 10 | Nitrate of soda, dissolved bone- black and muriate of potash. | 18,600 | 22,600 | +17,500 | +20,000 |
| 11 | Plaster, | 1,400 | 2,960 | +150 | +300 |
| 12 | Nothing, | 1,400 | 2,720 | - | - |

| ONIONS. | RESULTS OF THE ADDITION OF NITROGEN TO— | | | | |
|-------------------------|---|--------------------------|-----------------------|--|--------------------|
| | Nothing. | Dissolved Bone-black. | Muriate of Potash. | Dissolved Bone-black and Potash. | Average Result. |
| Unlimed (pounds), . . . | +813.33 | +7,313.33 | —300 | +8,450 | +4,064.17 |
| Limed (pounds), . . . | +1,333.33 | +5,593.33 | +2,460 | +9,340 | +4,681.67 |

| ONIONS. | RESULTS OF THE ADDITION OF PHOSPHORIC ACID TO— | | | | |
|-------------------------|--|---------------------|-----------------------|--------------------------------------|--------------------|
| | Nothing. | Nitrate of Soda. | Muriate of Potash. | Nitrate and Muriate of Potash. | Average Result. |
| Unlimed (pounds), . . . | +386.67 | +6,886.67 | +7,300 | +16,050 | +7,630.83 |
| Limed (pounds), . . . | +66.67 | +4,326.67 | +1,730 | +8,610 | +3,683.33 |

| ONIONS. | RESULTS OF THE ADDITION OF POTASH TO— | | | | |
|-------------------------|---------------------------------------|---------------------|--------------------------|---|--------------------|
| | Nothing. | Nitrate of Soda. | Dissolved Bone-black. | Nitrate and Dissolved Bone-black. | Average Result. |
| Unlimed (pounds), . . . | +1,750 | +636.67 | +8,663.33 | +9,800 | +5,212.5 |
| Limed (pounds), . . . | +8,930 | +10,056.67 | +10,593.33 | +14,340 | +10,980.0 |

| ONIONS. | RESULTS OF THE ADDITION TO NOTHING OF — | |
|-----------------------------|--|---------------|
| | Complete Fer- tilizer. | Land Plaster. |
| Unlimed (pounds), | +17,500 | +150 |
| Limed (pounds), | +20,000 | +300 |

The results of this experiment for this year are exactly similar in kind to those of the last two years, but the yield on the limed portion of the plots shows a falling off as compared with last year. A chemical test of the soil taken from this portion of these plots indicated that it is once more acid on all plots where muriate of potash and nitrate of soda have been used. There can be no doubt that the heavy applications of these fertilizers have again brought about conditions such that lime is once more needed. The principal points to which attention is called are : —

1. The need of lime is the most striking where the muriate of potash and nitrate of soda are the only fertilizers used.

2. The necessity for lime is strikingly evident where the muriate of potash alone is used.

3. Where dissolved bone-black is used in connection either with muriate of potash alone or with muriate of potash and nitrate of soda there is apparently far less need of lime. The dissolved bone-black, containing a considerable proportion of land plaster, supplies this element.

4. The best ripened crop was found where the dissolved bone-black was used, and attention is called to the desirability of using either this or acid phosphate freely wherever onions fail to ripen well.

5. The results make it evident that potash in abundance is highly essential for this crop. Potash alone in combination with lime gives a much better crop than either of the other fertilizers alone under similar conditions.

In conclusion, the belief is expressed that the soil of this field would be much benefited by an increase in its store of humus. Having received applications of fertilizers only for twelve years, and not having been in grass for six years, the stock of humus in the soil is very low and its physical con-

It should be noticed that plots 1 and 3 — manure alone — gave most hay, while plots 2 and 4 produced most rowen. This is undoubtedly due to the larger proportion of clover on these plots. Attention has been repeatedly called in previous reports to the fact that the free use of potash invariably tends to increase the percentage of clover in mowings. Combining the yields of hay and rowen, we find that manure alone has produced crops at the rate of 6,660 pounds per acre, while the lesser quantity of manure and potash has yielded 6,390 pounds. Here is a difference at the rate of 270 pounds per acre in favor of the larger quantity of manure alone. It is estimated that the manure alone, if purchased, is applied at the rate of \$30 worth to the acre; the lesser quantity of manure and the potash used with it are applied at a cost of \$23.60. We have, then, 270 pounds more hay produced where the annual cost of manuring amounts to \$6.40 per acre more than where the smaller crop is produced. Our results, then, for the past year are clearly favorable to the lesser manure and potash. The results of the two systems of manuring up to date may be briefly summarized as follows:—

1. The corn crops have been substantially equal in value.
2. The hay crops have been slightly larger on the plots receiving the more liberal application of manure alone; but these increases have been produced at a cost, where manure is estimated at \$5 per cord in the field, greater than their value.

X. — SPECIAL CORN FERTILIZER *v.* FERTILIZER RICHER IN POTASH.

The object of this experiment, as has been fully explained in previous reports, is to determine the most profitable combination of fertilizers to be used for the growth of corn in rotation with grass and clover, and especially to test the question as to whether the “special” corn fertilizers offered in our markets have such composition as is best suited for the production of corn under such conditions. The field is divided into four plots, and two of these plots — 1 and 3 — have yearly received an application of mixed fertilizers,

furnishing the same amount of nitrogen, phosphoric acid and potash as would be furnished by 1,800 pounds of fertilizer having the average composition of the “special” corn fertilizers analyzed at this Experiment Station in 1899. This average is as follows : —

| | |
|----------------------------|-----------|
| | Per Cent. |
| Nitrogen, | 2.37 |
| Phosphoric acid, | 10.00 |
| Potash, | 4.30 |

The fertilizers analyzed varied widely in composition, the range for each of the elements being shown by the following : —

| | |
|----------------------------|-----------|
| | Per Cent. |
| Nitrogen, | 1.5- 3.7 |
| Phosphoric acid, | 9.0-13.0 |
| Potash, | 1.5- 9.5 |

The other two plots — 2 and 4 — received annually an application of materials practically the same in kind and quantity as those recommended in Bulletin No. 58 for corn on soils poor in organic matter. These plots are supplied with a much larger quantity of potash and with less phosphoric acid than the other plots in the field. The fertilizers applied to the several plots are shown in the following table : —

| FERTILIZERS USED. | Plots 1 and 3 (Pounds Each). | Plots 2 and 4 (Pounds Each). |
|------------------------------|---------------------------------|---------------------------------|
| Nitrate of soda, | 30.0 | 50.0 |
| Dried blood, | 30.0 | - |
| Dry ground fish, | 37.5 | 50.0 |
| Acid phosphate, | 273.0 | 50.0 |
| Muriate of potash, | 37.5 | 62.5 |

During the past year this field has been in grass, having been seeded in the corn crop of last year in the latter part of the month of July. The season has been favorable to the hay crop, and the field has been cut twice, July 1 and August 28. The hay was housed in good condition. The tables show the yields : —

Yield of Hay and Rowen, 1901 (Pounds).

| Plots. | Hay. | Rowen. |
|--------------------------------------|--------|--------|
| Plot 1 (lesser potash), | 1,450 | 125 |
| Plot 2 (richer in potash), | 1,460* | 260 |
| Plot 3 (lesser potash), | 1,250 | 125 |
| Plot 4 (richer in potash), | 1,460* | 255 |

* Plots 2 and 4 weighed together on account of threatened storm; but, so far as could be determined by the eye, the yields of the two plots were substantially equal.

Average Yields per Acre (Pounds).

| Plots. | Hay. | Rowen. |
|--------------------------|-------|--------|
| Plots 1 and 3, | 5,400 | 500 |
| Plots 2 and 4, | 5,840 | 1,030 |

It will be noticed that the yields both of hay and rowen, but especially of the latter, were considerably heavier on plots 2 and 4 (*i.e.*, the plots which received fertilizer richer in potash) than on the others. The first crop on these plots was excessively heavy, and lodged to a considerable extent. The proportion of clover was much larger than on plots 1 and 3. The fact that the rowen crop on these plots was rather more than double that on the others was due chiefly to this difference in the proportion of clover.

The cost per acre of fertilizers applied at the rates used on plots 1 and 3 exceeds the cost per acre of fertilizers applied at the rates used on plots 2 and 4 by about \$4. We have, then, as a result of this year considerably larger yields at less cost. This field has been used continually in this experiment since 1891. The crop was corn for the years 1891 to 1896 inclusive, in 1897 and 1898 the field was in mixed grass and clover, in 1899 and 1900 in corn. The results of this experiment to date may be briefly summarized as follows : —

1. The crop of corn has been substantially equal on the two systems of manuring.
2. The crops of hay have been larger on the plots where more potash has been used, and the quality has been better.
3. The clover is relatively much more abundant on the plots where more potash is used. This difference is much

more striking at the present time than when the field was in grass in 1897 and 1898. In view of the well-known fact that the clover sod when turned is exceedingly favorable for succeeding crops, it is confidently anticipated that the differences in yields under the two systems of manuring will increase from year to year, and that the superiority of the mixture of fertilizers containing more potash will therefore become increasingly evident.

XI. — EXPERIMENT IN MANURING GRASS LANDS.

The system of using wood ashes, ground bone and muriate of potash, and manure, in rotation upon grass land has been continued upon the same basis as last year. There are three large plots, varying in size between about $2\frac{1}{2}$ and 4 acres. It may be remembered that according to the system followed each plot receives wood ashes at the rate of 1 ton per acre one year; the next year, ground bone 600 pounds, and muriate of potash 200 pounds, per acre; and the third year, manure at the rate of 8 tons. Both this year and last there has been used, on the plots receiving ashes, and ground bone and muriate of potash, respectively, nitrate of soda at the rate of 150 pounds per acre. This year, as last, a small application of nitrate of soda has been made to about one-half of the plot receiving wood ashes after the cutting of the first crop, for the purpose of determining to what extent such application is beneficial to the rowen crop. The system of manuring is so planned that each year we have one plot under each of the three manurings. The barnyard manure is always applied in the fall, the ashes, and the bone and potash, in early spring. The nitrate of soda used on two of the plots was applied to one April 18, to the other April 19. The past season has been favorable to the hay crop. All these plots have been cut three times. The total yields were at the following rates per acre: —

| | Pounds. |
|---|---------|
| On barnyard manure, | 7,367 |
| On wood ashes and nitrate of soda, | 5,817* |
| On bone, muriate of potash and nitrate of soda, | 6,815 |

* Actual yield, 6,679 pounds; above figure obtained by making reduction equal to increase believed to have been produced by application of nitrate of soda for rowen.

The average yield of the entire area for this year is 6,859 pounds. The average for the period 1893 to the beginning of the present year was 6,615 pounds per acre. The plots when dressed with manure have averaged 6,878 pounds per acre; when dressed with bone and potash, 6,649 pounds; and when receiving wood ashes, 6,309 pounds per acre. The average yields obtained on this field are surely very satisfactory. They are obtained at a cost for fertilizing materials applied which renders the hay crop decidedly profitable.

XII. — NITRATE OF SODA FOR ROWEN.

We began last year experiments calculated to show to what extent a small application of nitrate of soda applied after the removal of the first crop of hay would benefit the crop of rowen. The results last year showed increase in the rowen crop sufficient to render the application a paying one. These experiments have been continued this year, and have been carried out on two fields :—

1. On an old sod seeded in 1887, where the prevailing species is Kentucky blue grass, and which received in the spring an application of wood ashes at the rate of 1 ton to the acre and nitrate of soda at the rate of 150 pounds per acre. The first crop was cut June 17. The nitrate of soda was applied to two sub-plots, constituting about one-half of the field, at the rate of 150 pounds per acre on July 3. The results are shown in the table :—

Nitrate of Soda for Rowen. — Yields per Acre (Pounds).

| PLOTS. | Nitrate used. | Rowen, First Crop. | Rowen, Second Crop. | Total Rowen Crop. |
|---------------|--------------------------------|--------------------------|---------------------------|-------------------------|
| Plot 1, . . . | No nitrate, | 1,148 | 627 | 1,775 |
| Plot 2, . . . | 150 pounds per acre, | 1,590 | 732 | 2,331 |
| Plot 3, . . . | No nitrate, | 1,260 | 711 | 1,971 |
| Plot 4, . . . | 150 pounds per acre, | 1,676 | 880 | 2,556 |

The average rates of yield per acre are :—

| | |
|-----------------------|------------------|
| No nitrate, | Pounds. 1,873 |
| Nitrate, | 2,444 |

The average increase due to the application of 150 pounds of nitrate of soda is therefore 571 pounds. At the current price for nitrate of soda, this increase has cost a little more than one-half a cent per pound.

2. Nitrate was tried upon a timothy sod seeded in 1899. Four equal plots were laid off, and to two of them nitrate was applied at the rate of 150 pounds per acre. The first crop was cut July 8; the nitrate was applied July 17; the rowen crop was cut September 16. The table shows the calculated results per acre:—

Nitrate of Soda for Rowen. — Yields per Acre (Pounds).

| PLOTS. | Nitrate applied. | Yield of Rowen. |
|-----------------|--------------------------------|-----------------|
| Plot 1, | No nitrate, | 436 |
| Plot 2, | 150 pounds per acre, | 953 |
| Plot 3, | No nitrate, | 463 |
| Plot 4, | 150 pounds per acre, | 463 |

The average rates of yield per acre were:—

| | |
|-----------------------|-------------|
| No nitrate, | Pounds, 449 |
| Nitrate, | 709 |

The average increase is therefore 259 pounds, which, at the current price for nitrate of soda, costs about $1\frac{1}{6}$ cents a pound. The use of nitrate for rowen is therefore profitable in the case of the Kentucky blue grass sod, unprofitable in the case of the timothy. Neither the blue grass nor the timothy, however, are varieties characterized by a free or abundant second growth. The results of the application of nitrate of soda for rowen are likely to be better for other varieties, such as orchard grass, the fescues and rye grasses.

XIII. — EXPERIMENT IN APPLICATION OF MANURE.

Observation of the results obtained for a number of years from the application of manures spread in late fall or winter and allowed to lie upon the surface until spring had

led to the conclusion that an experiment was needed to determine whether that practice is wise. The previous history of one of our fields had left it in such condition that we could compare two methods only of application. This field had previously been divided into five plots, each of which had for some ten years received different manurial treatment. These plots were comparatively wide, and it was proposed to divide each in the middle, designating one-half of each plot north, the other south. The original plots had been numbered 1 to 5. The previous manurial treatment had been as shown in the table : —

| Plots. | Fertilizer used. |
|-------------------|---|
| Plot 1, | Barnyard manure, 10 tons per acre. |
| Plot 2, | Wood ashes, 1 ton per acre. |
| Plot 3, | No manure. |
| Plot 4, | Fine-ground bone, 600 pounds per acre; muriate of potash, 200 pounds per acre. |
| Plot 5, | Fine-ground bone, 600 pounds per acre; sulfate of potash, low grade, 400 pounds per acre. |

In 1899 the entire field was evenly manured with manure from well-fed milch cows. The topography of the field is such that there is considerable slope lengthwise of the plots, although the lay of the land makes it possible that under exceptional circumstances there may also be a little wash from one plot to another. The crop in 1899 and 1900 was corn, — in 1899 for the silo, in 1900, husked ; in 1901 the crop was Japanese barnyard millet.

The plan of manuring followed during 1900 and 1901 may be thus described : —

Four of the plots — 1, 2, 3 and 4 — receive an application of carefully saved manure from milch cows at the rate of 10 tons to the acre. Plot 5 receives an application of stable manure at about the same rate. The cow manure when applied is comparatively fresh and unfermented. The four plots receive this manure each at a different date, our practice being to remove the manure from the pits as it accumulates as soon as the quantity made is sufficient for one plot.

Whenever a plot is manured, the loads as hauled are placed alternately one on the north and the other on the south half of the plot. The load for the north half is spread, that for the south half is put into a heap, all the manure for that half being placed in one large, well-shaped heap. The weight of manure for each half is the same. The manure for plot 1 is applied in late fall, plot 2 in early winter, plots 3 and 4 in the order named, at dates still later in the winter. The stable manure used on plot 5 has been handled in a similar way, the application to this plot commonly being made rather late in the winter; and the manure when applied has been partially rotted, and hot and steaming at the time it was hauled. Our practice has been to plough the field in mid-autumn, and then to sow a cover crop, — usually rye. The manure which is put into heaps is spread in spring shortly before the ground is to be planted, and the whole area is immediately ploughed, the manure applied during the winter as well as that just spread from the heaps being at that time turned in. The results for the three years, viz., the first, when all plots were treated alike, and the last two, when the manure was applied as just described are concisely shown in the tables: —

Yield of Corn and Millet, in Pounds per Plot.

| Plots. | PREVIOUS MANURING. | 1899 | | 1900 | | 1901 | |
|--------|------------------------------|--|-------------|-----------------------------|----------------------------|-----------------------------|----------------------------|
| | | CORN, GREEN (BOTH HALVES MANURED ALIKE). | | CORN, EARS AND STOVER. | | BARNYARD MILLET HAY. | |
| | | North Half. | South Half. | North Half (Manure spread). | South Half (Manure piled). | North Half (Manure spread). | South Half (Manure piled). |
| 1 | Barnyard manure, . . . | 5,995 | 6,320 | 1,920 | 1,983 | 1,375 | 1,625 |
| 2 | Wood ashes, . . . | 6,020 | 5,785 | 1,825 | 1,955 | 1,050 | 1,380 |
| 3 | No manure, . . . | 2,900 | 4,215 | 1,380 | 1,725 | 740 | 1,310 |
| 4 | Bone and muriate of pot-ash. | 5,010 | 4,590 | 1,630 | 1,795 | 1,040 | 1,515 |
| 5 | Bone and sulfate of pot-ash. | 4,805 | 5,470 | 1,645 | 2,015 | 1,130 | 1,680 |

Relative Yield of Corn and Millet, in Percentages.

| PLOTS. | 1899 CORN (BOTH HALVES MANURED ALIKE). | | 1900 CORN. | | 1901 MILLET. | |
|-------------------|--|----------------|--------------------------------------|-------------------------------------|--------------------------------------|-------------------------------------|
| | North Half. | South Half. | North Half (Manure spread). | South Half (Manure piled). | North Half (Manure spread). | South Half (Manure piled). |
| Plot 1, | 100 | 105.4 | 100 | 103.4 | 100 | 118.1 |
| Plot 2, | 100 | 96.1 | 100 | 107.1 | 100 | 131.4 |
| Plot 3, | 100 | 145.3 | 100 | 125.0 | 100 | 177.0 |
| Plot 4, | 100 | 91.7 | 100 | 110.4 | 100 | 145.6 |
| Plot 5, | 100 | 113.8 | 100 | 122.5 | 100 | 148.7 |

It will be seen that the two halves of the several plots were not quite even in fertility, as indicated by the yields of the first year, at the start. The greatest difference was found on plot 3. The north half of this plot suffers from spring or ooze water to a greater extent than the south part. We must be cautious, therefore, in attaching importance to the largely increased difference in yield on that half of this plot manured in spring for the past season. It will be noticed, however, that, while there are differences in the degree, there is a marked tendency to increased superiority in favor of spring application on the other plots of the field as well as on this.

This experiment will be continued; but it has seemed wise to call attention to the results so far obtained, for the reason that the conditions on this field as regards the nature of the surface are similar to those existing in the fields on many farms, and for the further reason that the results certainly indicate that there is grave reason to doubt whether application of fresh manure during the winter and allowing it to lie upon the surface until spring is wise. In conclusion, I should perhaps call attention to the fact that, while the difference between the south and the north half of plot 3 may be to a considerable degree due to the different natural conditions, it seems only reasonable to conclude that it may be in part also due to the fact that the fertility of this plot at the start was much lower than that of the others, as it

had been cropped for many years without application of manure or fertilizer of any kind. On the other plots, which had been well manured in preceding years, it would not be strange should a good yield be obtained on the north half, even although the manure spread there during the winter may have suffered serious loss. The fact that the difference between the north and south halves of plot 1 during the past two years is less than on any of the other plots, serves to confirm this view; for it will be remembered that plot 1 had yearly received a fairly liberal application of barnyard manure for a long series of years previous to the beginning of this experiment.

XIV. — ALFALFA AS A FORAGE CROP.

There is at the present time so much interest in alfalfa as a forage crop that attention is called to the fact that the results obtained at this station have been distinctly unfavorable. Alfalfa has been under trial in a small way for a considerable number of years, and we have never succeeded in obtaining results encouraging to its general introduction.

It is well known that alfalfa thrives best on soils where the water level is well below the surface, and where the texture of the sub-soil is not too compact. We have not perhaps an ideal soil for alfalfa on the college estate. It has been tried, however, on a considerable number of fields, some of which it would seem must possess soil with the right characteristics. It is known, further, that for success with alfalfa the soil must be rich in lime. Our soils are not naturally rich in this constituent. In one of the experiments of the past few years which will now be briefly described we have made a heavy application of lime to one-half of the plot.

A. — Alfalfa on Campus Slope.

The field known as campus slope falls off gradually toward the west, affording perfect surface drainage. The surface soil is fine, medium loam, which gives excellent crops of potatoes, corn or clover. The sub-soil to the depth of three or four feet is of the same general character as the surface

soil, though containing, of course, less humus. At the depth of five to six feet begins a somewhat open-textured gravel,—a quality of gravel which makes quick-bedding road material, but which as it lies is not at all of the nature of a hardpan. The water level of this field is well below the surface. In 1899 the field produced a crop of potatoes; for the two previous years it was in mixed grass and clover. It was manured in the spring of 1900, at the rate of 4 cords to the acre; the manure was ploughed in. The plot, which was 40 feet in width and 152 feet long, was divided into two strips, and to one of these lime was applied at the rate of $1\frac{1}{2}$ tons (air-slaked) per acre. After ploughing, fertilizers were applied at the following rates per acre:—

| | Pounds. |
|--|---------|
| Sulfate of potash, high grade, | 250 |
| Acid phosphate, | 400 |
| Steamed bone, | 200 |

The seed was sown in rows ten inches apart on May 22. The plot was hand-weeded and hoed several times throughout the summer. The growth was very slow, and no crop was harvested. This alfalfa passed through the winter in good condition. The plot was lightly harrowed on April 16; on May 1, it was hoed. On May 6, fertilizers were applied in the same amounts as in 1900. Early in the summer it was noticed that the alfalfa was somewhat better on the limed half of the plot. To the west end of both limed and unlimed portions—a small application of soil from an alfalfa field in Kansas was made in the spring of 1900. This was for the purpose of testing whether deficiency of bacteria of the right kind was the probable cause of the slow growth of the crop. It was believed that the Kansas soil would furnish these. No particular difference was noticed during the first season; but by the middle of June the past season it could be plainly seen that the growth where the Kansas soil had been spread was superior to that on the other parts of the plot. The plot was cut three times during the season, June 20, July 21 and September 6, each time when in early bloom. The yields per plot were as follows:—

Yield of Alfalfa (Pounds).

| | June 20. | July 21. | September 6. | Total Crop. |
|-------------------------|----------|----------|--------------|-------------|
| Without lime, | 175 | 70 | 130 | 375 |
| With lime, | 290 | 105 | 170 | 565 |

The total yield was at the following rates per acre : unlimed, 5,374 pounds ; limed, 8,088 pounds. These are green weights, and they represent a very small and unprofitable product. It is of course possible that the poor growth may be largely the result of the absence of bacteria of the right species in suitable numbers ; but the yield even on that part of the plots to which the Kansas soil was applied was exceedingly small.

B. — Alfalfa on Field B.

The second plot on which we now have alfalfa is one of those in field B, which has been yearly manured with bone meal at the rate of 600 pounds, and muriate of potash, for the last two years, at the rate of 250 pounds per acre. The soil of this field is a moderately heavy loam. It is tile-drained, by means of one line of tiles running through the middle of the plot ; the depth of this drain varies between three and four feet. This plot has recently produced good yields of a number of our common farm crops. The seed was sown on this field in the spring of 1900, in drills, as in the other field, and the crop was very carefully cared for. Nothing was harvested in 1900 ; but the crop, which was just beginning to bloom, was cut on July 1, as it showed signs of blight. That which was cut was allowed to remain on the ground. It may be here remarked that this practice has been strongly recommended by farmers who have had experience in the growth of alfalfa in New York, where, as here, the crop is somewhat subject to a rust-like blight. The experience of these farmers has led them to conclude that when this blight shows itself the crop must be immediately cut ; otherwise, as the leaves are soon destroyed, the vitality of the plants is seriously lowered. Their experience is that, if the crop be promptly cut and allowed

to remain on the ground, a healthy growth soon takes place. Such observations as we have been able to make here indicate that this practice is beneficial.

In the spring of the past year it was found that most of the plants had been lifted from one to two inches by the frosts of winter and spring. Nearly all of them, however, appeared to be alive, and they soon started fairly well, though the growth did not present a good color. On April 13, fertilizers in the usual amounts were applied broadcast. On April 16, the field was harrowed lightly with a smoothing harrow. The crop was cut three times, as follows:—

June 20, just coming into bloom, 2 to 2½ feet in height, the lower leaves beginning to show spots, and turning yellow. Yield, green, 910 pounds.

July 22, in bloom, showing a little blight. Weight, green, 465 pounds.

September 6, beginning to blossom, slightly affected by blight. Weight, green, 440 pounds.

The area of the plot is about two-fifteenths of an acre. The total green weight is 1,815 pounds, which is at the rate of 13,610 pounds per acre. The crop has been once hand-hoed during the past season. The yield of rather less than 7 tons to the acre is much less than could have been obtained from clover, at far lower cost for labor.

In conclusion, these results are presented not as conclusive, but rather to indicate the need of caution on the part of our farmers in the direction of experiments with this crop. True, it is the most valuable forage crop known in the United States in many sections; but it cannot be regarded as by any means certain that it can be made to succeed on the average soils of this State. If successful anywhere, it seems likely to be on deep, mellow soils, of alluvial or drift formation, and where the water table is well below the surface.

XV. — AN OLD CROP UNDER NEW NAMES.

Pearl millet has been advertised by seedsmen for many years, and has been occasionally grown by some of our farmers. Within the past two or three years seedsmen in different parts of the country have advertised what, as a

result of our comparisons, it is concluded is precisely the same variety under new names. The names which have been brought to our attention are Mand's Wonder Forage Crop and Brazilian Millet. Seed offered under these names was procured in preparation for this season's work from the so-called originators or introducers. We also secured seed from some of our prominent seedsmen who in turn had secured it from would-be introducers. The most careful comparisons throughout the entire season failed to disclose any difference. Mand's Wonder and Brazilian millet, so called, appear to be identical in every way with Pearl millet. The latter seed can usually be obtained of seedsmen at about 10 cents per pound, while under the new names the prices charged are much in excess of this figure. Such trials of Pearl millet as have been made here have led to the conclusion that it is not a crop which is likely to prove of any considerable value, unless it may be upon very light, dry and warm soils. The crop has been described and commented on at length in previous reports.

REPORT OF THE BOTANISTS.

G. E. STONE, R. E. SMITH.

The dying of cut-leaved birches.

The present status of chrysanthemum rust in Massachusetts.

The effects of desiccation on soil.

Melon failures.

Stem rots and wilt diseases.

The present status of asparagus rust in Massachusetts.

Sterilization of soil in greenhouses for fungous diseases.

Similar lines of routine work and investigation have been followed in this department as outlined in former reports. During the summer, \$400 was expended on repairs and improvements of the building, including part of the greenhouse, and more particularly upon the trucks and tracks utilized for pot experiments. The shed and large unheated greenhouse which were designed for truck experiments have been retracked and concreted, and the original trucks, which were rather primitive in construction, have been remodelled and provided with roller bearings.

Certain species of fungi affecting shade trees and economic crops have been rather common during the year. Among these may be mentioned the *Glæosporium* (*G. nerrisequum* (Fekl.) Sacc.), which caused more or less defoliation of the white oak throughout the State. In some instances the foliage was affected to such an extent that half of it fell off which was, as usual, replaced later on by a new growth of leaves. So far as I am aware, no treatment has ever been given the oak for this disease. The fungus appears to be confined to the lower portion of the tree, and no doubt a good spraying of this part with some standard fungicide as soon as the leaves have unfolded and more or less developed

would control this outbreak. This treatment is only recommended where such trees occur in valuable situations, such as on lawns, etc., and where the expense of spraying would equal the utility and value of the trees for shade or æsthetic purposes.

The sycamore has also shown, as it is very likely to each year, more or less defoliation from a similar fungus.

The *Gloeosporium* on the maple, previously mentioned in our reports, has been more or less common, causing some injury to the foliage, and a leaf-scorch entirely due to a lack of water supply, causing a drying up of the leaves, has been observed to some extent.

This division frequently received specimens and letters relating to these diseases. They do not constitute very serious maladies, as a rule, and the question of treatment is usually one based upon the utility of the tree under consideration.

Many elm leaves are frequently subject to the fungus known as *Dothidea Ulmi*, (Duv.) Fr., and the European linden in some localities suffers from the effect of a leaf spot (*Cercospora microsora*, Sacc.). Both of these fungi cause the foliage to become spotted and to fall prematurely. It would not be a bad idea once in three or four years to spray badly affected trees, so that they may at least once in a while have a clean crop of foliage, which would exert considerable influence on the growth of the tree.

Other fungi which have been more or less common are the tomato spot or mildew, leaf blight and leaf spot, the quince rust, melon blight, bean anthracnose and asparagus rust. Bacterial rot on cabbage has caused some loss to this crop, and it was noticed in fields that had been planted to cabbages for the first time.

THE DYING OF CUT-LEAVED BIRCHES.

The dying of cut-leaved birches became quite a noticeable feature in some places in the eastern part of the State this past summer. The cause of this trouble was incidentally due to borers, but in all probability it was primarily brought about by the drought last season. Probably many

of these trees could have been saved if they had been cut back in time, in order to correlate top growth with that of the roots. Many of our maple trees, when grown on dry, gravelly soil, suffer greatly during a season of drought, and the effect of this suffering is usually increased by the presence of borers in the following years. In cities the restricted growth of roots, caused by pavements, sidewalks, regrading, etc., induces similar pathological conditions in the tree, which are sooner or later followed by the same mischief-makers.

THE PRESENT STATUS OF CHRYSANTHEMUM RUST IN MASSACHUSETTS.

The chrysanthemum rust was first noticed in this State in the fall of 1896,* this being the first recorded instance of the appearance of the rust in the United States. The following year it became more widely disseminated in Massachusetts, and has since extended over the larger portion of the United States.† We have never, however, regarded its appearance in this State as a matter of very serious consequence; nevertheless, we have felt it necessary to keep a watchful eye over its presence in our midst. During the past fall we have made an effort to obtain, by means of circulars, whatever information could be secured; and in so far as its occurrence in this State is concerned, this information has borne out our conception of it.

Only one stage of the rust, the uredo, has been found on the plants affected in Massachusetts. In the absence of the other stages which are characteristic of rusts, it might be expected that it would not obtain a very strong foothold. Upon this point Dr. Arthur‡ writes as follows: “Another circumstance much in the cultivator’s favor is the propagation of the disease without the formation of the customary teleuto spores or third stage. Not only does this render the disease far less persistent, but without doubt indicates that it is less vigorous in its attacks. In general, when a rust is confined

* Annual report of the Hatch Experiment Station for 1896, pp. 276-279.

† For details connected with the spread of the rust, etc., consult Bulletin No. 85, October, 1900, Indiana Agricultural Experiment Station.

‡ Bulletin No. 85, p. 128, Indiana Agricultural Experiment Station.

to the uredo forms for a number of generations, its vitality is much reduced, and also its power of injuring the crop. So long as the teleuto spores do not make an appearance in this country, the careful cultivator may feel assured that a moderate amount of timely effort will enable him to rid his establishment of the rust."

From data contained in this circular, it appears that the rust was most prevalent during the years 1897 and 1898, or, in other words, during the first year or two of its outbreak. At this time it became more generally distributed over the State, and of course there was more infection as a whole. It also affected the individual plants more severely during the first outbreak than in the later ones. During the last three years it has shown, as a whole, a marked tendency to decrease in this State. There are, to be sure, individual growers who report an increase; but this increase is perhaps due to their methods of cultivation, and not taking sufficient care to propagate from clean stock. One-third of the growers state that they never had the rust on their plants, and were familiar with it only as they had seen it on other stock, while others have only experienced a slight infection one year. One florist who cultivates 40,000 plants, states that he has not had the rust for three years, or since 1898, and at that time he had it only to a very slight extent. The amount of infection which has been prevalent varies from .1 per cent. to 50 per cent., the latter figure being exceptionally high, for very few have had even 25 per cent. as a maximum amount of infection. The financial damage to the crop is far less than the above, and in most instances it amounts to nothing. The worst injury appears to be to the gardeners' pride, inasmuch as a large percentage of the plants are grown for competition in shows, and even a slight blemish caused by two or three rust pustules on a single leaf, is very annoying to skilful gardeners, who take pride in exhibiting their plants. Most gardeners agree that weak stock is the most susceptible to rust; and if weak, infected plants are allowed to remain in close proximity to strong, healthy ones, they too will subsequently become infected. The variety known as the Queen is singled out as

the one most susceptible to infection. One grower believes that pot-grown plants are more susceptible to rust than those planted in benches.

The remedies suggested by the different growers consist in hand-picking the affected leaves, selecting clean, strong stock, discarding susceptible varieties, and inside culture. These suggestions appear to us very reasonable, and if they are carefully carried out there is at present little reason to doubt that it can be practically eliminated. In regard to the practice of inside culture during the summer, we find that many excellent growers lay much stress on this practice, and from what we have seen of it we consider it very essential in order to obtain plants free from rust. The reason that inside culture results in less infection is probably due to the avoidance of mists and dews on the foliage, hence furnishing less favorable opportunity for rust spores to germinate and cause infection. Care should also be taken to keep all unnecessary water off the foliage in cultivating in the greenhouse. One successful grower makes the following statement: "I have found that when plants were planted in benches in a good house, where plenty of air could be admitted and the soil kept in good physical condition, they were almost never troubled with rust."

Most growers are unanimous in considering the chrysanthemum rust of little consequence, and others look upon it as a thing of the past. There are a few, however, who have not succeeded in subduing it, who still think it a serious disease. Some have resorted to spraying, with results that amount to little more than partial suppression. It appears from our own observations, as well as from those obtained from the most successful growers of this plant, that the proper remedy lies in the judicious selection of healthy, rust-free stock, and inside cultivation. If, however, any of the leaves become infected, they should be removed and burned immediately; and if a plant is badly affected, it should be destroyed. In whatever manner the plants are cultivated, whether in-doors or out-doors, endeavor to keep the dew and moisture off the foliage as much as possible.

THE EFFECTS OF DESICCATION ON SOIL.

The practice of desiccation or drying greenhouse soils by aid of the heat of the summer sun has been in vogue with us for some time, for the purpose of observing what effect such treatment would have on certain organisms. We have already shown that the *Sclerotinia* or the drop fungus when dried is greatly accelerated in its activity, which increases to a great extent the amount of infection in the succeeding crop of lettuce. The resting spores of many other plants are undoubtedly affected in the same way. There are other effects of drying on the soil which prove very destructive to the development of lettuce plants, although we have not observed this effect upon other species. On lettuce we have observed this repeatedly, and the characteristic results of such drying are manifested in a stunted growth and abnormally colored and worthless crop. The crop scarcely ever attains more than one-third of its size. The texture of the plants is poor, being thick and tough, and inclined to crinkle. That this is caused by desiccation alone is shown by the fact that wherever any drip from the roof fell upon the soil during the summer rains, the plants growing in such places were always normal. Distinctly sharp lines can be observed in a lettuce crop grown under such conditions, owing to the difference in development brought about by desiccation and the presence of a small amount of water due to dripping. Instances have come to our notice where large houses devoted to lettuce have been allowed to become quite dry, with the same result on the crop as noted above. The remedy for this trouble is obvious; namely, not to allow the house to become too dry in summer, but to keep the soil more or less supplied with water. If such drying occurs, the soil can be entirely renovated by applying hot water or steam to it, as we have already shown more than once.

MELON FAILURES.

No trouble with plants has been more general in New England the past season than that attending the growing of muskmelons. In a great many cases this crop has been a

total loss, and almost without exception the yield has been greatly diminished and the quality of much of the fruit put on the market impaired. In two previous reports (1899 and 1900) we have mentioned this subject, but the trouble has never been so general before. The melon blight described in our report for 1898 was found to be due to a leaf spot fungus of the form called *Alternaria*. This disease appeared in the latter part of August, as the fruit was approaching maturity, and soon killed the vines so completely that the crop in the affected field was a total loss. The trouble was not at the time general throughout the State or even in the immediate region, though it had previously been known in other States. The following year the same disease occurred quite abundantly, and along with it the well-known cucumber anthracnose (*Colletotrichum lagenarium*) was very prevalent on muskmelons and watermelons. This second disease appeared earlier in the season than the *Alternaria*, coming on in July. Between the two diseases and the gradual spread of the trouble the damage to the melon crop was considerably greater in 1899 than during the previous year, and many growers determined to give up this crop. In 1890 more or less trouble was experienced, but not to a marked degree. In that year, however, there appeared in the State upon greenhouse cucumbers for the first time, so far as known, since 1889, the downy mildew of the melon, cucumber and similar plants. During the past season of 1901 complaint has been general from all sections of the State of the complete failure of the muskmelon crop. Examination of the first material sent in revealed the fact that still a third disease had come upon this unfortunate plant, — the downy mildew was abundant on every affected leaf. This proved to be the case in every instance. Affected plants from Amherst, South Amherst, Belchertown, Worcester, Lancaster, Fitchburg, Belmont, Andover and other towns in the State all showed the downy mildew (*Plasmopara cubensis*), while in most instances one or both of the other two fungi were also present on the same leaves.

The consideration of this trouble is therefore a complex one, and each of these destructive fungi must be taken into

account. It must be remembered that each is a definite organism, growing parasitically upon the leaves of the melon, and having its regular course of development.

Taking up each disease separately, we find the *Alternaria* less abundant this year than when it first appeared. No instances have been found, as was certainly the case in 1898, of this fungus alone being the cause of the trouble. It may be mentioned here, however, that specimens of the melon blight, now so prevalent in the extensive Colorado melon districts about Rocky Ford, sent by Mr. H. H. Griffin of the Colorado Experiment Station, show only a fungus apparently identical with our *Alternaria*. All our experience indicates that trouble from this source alone is not to be looked for until comparatively late in the season, — not, probably, before August 1.

The anthracnose (*Colletotrichum*) causes a well-known leaf blight on greenhouse cucumbers, and has been very common on melons the past season. It is more usual on water-melons than muskmelons, having often been the cause of serious damage to the former. On both species it attacks the fruit as well as the leaves, causing spotting and decay. This fungus is not, apparently, as definite in the time of its appearance upon melons as either of the others, but is liable to come on earlier, and generally does so when abundant.

The downy mildew has been comparatively unknown in this State up to the present outbreak. It is now abundant on greenhouse cucumbers, and occurred everywhere on muskmelons last summer. Farther south it has been well known on these plants for some time. The appearance of the fungus on melons is not to be looked for here before August 1 and quite commonly it did not become destructive last season until September 1.

A typical case of the simultaneous occurrence of these three diseases occurred at Mr. A. A. Marshall's place at Fitchburg, Mass., where the growing of muskmelons is made a specialty. Eight acres were grown, all in one field, and all of one variety, the Miller's Cream. At one end of the field the ground was slightly rising, and on this portion the same crop had been grown the preceding year, the rest of

the field being new to melons. About July 22 it was first noticed that a blight was appearing on the vines on the old ground. This did not increase very rapidly or cause any serious damage for some time. When visited, on August 17, picking had just commenced, and the crop was mostly in excellent condition. In the most affected part a few plants were dead or had been pulled out, and many leaves were spotted; some of the fruit also showed spotting and decay. Examination of the badly affected plants, *i.e.*, those which had been earliest attacked, showed the presence of the anthracnose in great abundance, some *Alternaria*, while the downy mildew appeared to be just coming on. The decay of the fruit was due entirely to the anthracnose. From this time on the trouble spread rapidly to other parts of the field, and in this later attack the mildew was almost entirely the cause of the trouble. In other places also, where no disease appeared until about September 1, the rapid destruction which followed was due to the same cause.

From all the cases reported it is evident that, except for the rather unusual case of the anthracnose becoming abundant in July, the chief trouble with the melon crop comes on about September 1, or in the last days of August, just as the fruit begins to mature. The appearance of a badly blighted field is a most discouraging one to the melon grower, the ground being covered with good-sized but mostly flavorless worthless melons among the dead vines. It therefore comes about that a saving of the vines for two weeks at this time is of supreme importance, and even one week means often the difference between profit and loss to the grower.

Treatment.—In order to gain this period in the life of the plant, the most obvious methods are by getting an early start, by the use of early varieties, and by protecting the plant by spraying. Each of these is of practical importance. The first is often practised by starting the plants in hot-houses or frames, and transplanting later to the open field. This method has been used with promising results, and deserves a trial wherever practicable. The choice of varieties is largely a matter of personal taste in this crop,

many growers having their own strains, from which they would depart only with great reluctance. It can only be said that the earliest varieties which are otherwise satisfactory should be grown. From the present outlook, the early fruit must form the bulk of the melon crop.

Spraying. — Considerable success in preventing the attacks of all these fungi has been obtained in various experiments and places by spraying melons and cucumbers. No very extensive results have been obtained, however, with the melon crop in this State. Mr. Marshall's fields were sprayed seven or eight times during the season with various copper fungicides. All the plants were sprayed, so that it is impossible to say just what was gained, and whether the anthracnose which appeared in July would otherwise have proved more destructive. Judged by the case described in our 1900 report, there was a decided gain in this respect. Certainly Mr. Marshall's vines kept alive some time longer than the average in the State or vicinity, and the spraying appeared to have been of advantage. Mr. L. W. Goodell, the Pansy Park seedsman, sprayed with Bordeaux mixture, and in his field a gain of from one to two weeks in the life of the most thoroughly sprayed portions was plainly apparent. Thorough spraying of melons is difficult, for two reasons, — the prostrate position of the plant, making it almost impossible to spray the under side of the leaves, and the rough, hairy surface of the leaf, to which the spray does not readily adhere.

At present the following recommendations seem advisable for this trouble: try, by the methods suggested above, to mature the crop as early as possible: spray with Bordeaux mixture with great thoroughness throughout the season, beginning as early as July 1.

STEM ROTS AND WILT DISEASES.

Troubles of this sort, in which affected plants show a wilting and withering of the leaves, caused by a more or less rapid decay of the stem, appear to be largely on the increase in cultivated plants. Three such diseases are of special importance at present, owing to their rapid increase.

These are the stem rots of the chrysanthemum, carnation and aster, all of comparatively recent occurrence, but becoming more and more serious each year.

Chrysanthemum Stem Rot. — This disease has been known in Massachusetts only during the past two years, but has rapidly increased, and is considered by many growers as the most serious trouble threatening this important plant. It is characterized by a slow fading and withering of the leaves, beginning towards the bottom and gradually working up the stem. The flower develops poorly or not at all, and the whole plant finally dies prematurely. The cause of the disease is a fungus which grows in the stem and fills up the large ducts or vessels through which the water must pass in coming up from the roots. The development of this fungus has not yet been closely followed; but, since it is a species of *Fusarium*, similar forms of which cause like diseases in other plants, there can be but little doubt that the plant is first attacked from the soil, whence the fungus spreads into the stem and on up through it to a considerable height. As the pores become more and more clogged with the fungous growth, the water supply to the leaves is diminished, and consequently they gradually die and wither away. It is noticeable that this disease appears most commonly as a result of conditions favoring “damping off.” Where young plants are crowded in flats or beds, those in the centre are generally the ones to show the trouble. This is likewise true with the other diseases of this class mentioned here, and such conditions should be avoided. The soil is to be looked upon as the chief source of infection in all such troubles. There is no danger of contagion in well-rooted plants by spores in the air, as with rusts, mildews and similar diseases. Healthy propagating stock, fresh soil, or that which has been sterilized,* and hygienic conditions, are the most effectual means of controlling such a trouble as this.

Carnation Stem Rot. — This disease has been longer and more generally known than that of the chrysanthemum, but

* One florist who grew 125,000 chrysanthemums sterilized the soil in ten houses, 200-300 feet long and 20-30 feet wide. Three and one-half houses, 300 feet long and 18-40 feet wide, in which carnations are growing, were also sterilized. The result of this experiment has not as yet been ascertained.

it is of comparatively recent occurrence. Most growers, however, know and fear it more than the rust or any other carnation disease. It has been found that there are in reality two distinct stem rots of the carnation, caused by two different fungi. In one a soft rotting of the whole stem occurs just at the surface of the ground, thus killing the plant quickly and completely. This is caused by the *Rhizoctonia* fungus described in our Bulletin No. 69 as the cause of a lettuce rot, and what is said there in regard to this destructive parasite applies equally well in the carnation disease. Since this fungus produces no spores to disseminate it in the air, but is limited to growth in the soil, sterilization by means of steam gives absolute results in preventing the disease, if healthy propagating stock is used. Another carnation stem rot is caused by a *Fusarium* similar to that in the chrysanthemum. In this case a soft, rapid decay does not occur, as in the *Rhizoctonia* disease, but the fungus works up through the pores of the stem, gradually clogging them, and the plant slowly fades away and dies. The stem goes to pieces in the last stages of the disease, but may be badly affected some time before this, the first symptoms appearing in the wilting of the plant. The use of healthy stock and fresh or sterilized soil is to be strongly urged where this disease has appeared, as well as the removal of all affected plants and the soil near them from the bed.

Aster Stem Rot. — A *Fusarium* stem rot of the China aster is very common and destructive, and seems to be on the increase. This disease will be more fully described in a bulletin of this division. Our investigations have shown that it is always first contracted as a “damping off” in the seed bed. Some plants die at this stage, but many live to be set out in the bed. Here the disease manifests itself at almost any time, by a gradual wilting, fading and death of the plant. Only in the last stages does the rotting of the stem appear; long before this the pores are clogged by the fungus, and wilting produced as in the other diseases. So far as our results go, it is possible to entirely avoid the trouble by starting the plants in the open ground, or otherwise avoiding “damping off” conditions. Thousands of plants

thus started have been grown on land badly infected with the disease, without a single case of stem rot. In this case, however, some other troubles with a similar effect must also be considered, particularly the attacks of root lice, one of the worst pests with asters. All of these will be fully discussed in the forthcoming bulletin.

THE PRESENT STATUS OF ASPARAGUS RUST IN MASSACHUSETTS.

The asparagus rust made its appearance as usual in either one form or another during the summer and early fall. In July and August outbreaks of the uredo stage were perhaps not so severe, as a whole, as in some other years; nevertheless, it was severe enough to be likely to cause damage to the crop next year. The distribution of the rust in this State remains nearly the same as it has for some years, although within the last two years there has been a slight tendency for the uredo stage to show itself on some beds which heretofore have never presented anything but the teleuto spore stage. These beds appear to be in soil presenting more water retentivity than those soils upon which the rust has caused the most injury in years past. In this connection it should be stated that, while the uredo stage has shown on them, it does not occur nearly so early or so severely as on the lighter soils. The uredo spore stage occurred in the latter part of August on these beds. Other than these few instances, the distribution of the uredo spore stage, which constitutes that form of the rust causing practically the only injury, is about the same as it has been.

The rust constitutes a very serious factor to asparagus growers, especially to those who have a large number of acres located in infested regions. On account of the high prices of asparagus in the market last spring, the financial returns were not so unfavorable as they might have been, considering the small yield due to the effect of rust. The great difficulty that now exists with those growing asparagus on dry soils subject to rust infection is in starting new beds. The young beds rust so much earlier than the old ones that they suffer more severely as a consequence, and in many cases

are so weakened that it looks questionable whether they will ever develop into anything of value.

We have previously attempted to show that the outbreak of the uredo spore stage in this State bears a direct relationship to the water retentivity of the soil; that is to say, during a season of drought, soil capable of holding a small percentage of water becomes exceedingly dry, and it is on these soils that plants suffer. There has been nothing observed to disprove this idea, as we still find the uredo or injurious stage of the rust usually occurring on those soils which are light, and we do not get this stage on plants grown on other soils. We have made a great many additional analyses of soils of the State during the past two years, and the results obtained from such analyses bear out these conclusions. It is also noticeable that in those regions where the soil is lighter and more porous the uredo spore infection shows itself earliest each season, and where the soil is heavier and more compact infection is later, hence doing less damage. Beds situated in regions where the latter conditions prevail have not been damaged nearly so much in the last five years as those situated in the lighter and more porous soils.

The foundation of the idea of the relationship existing between the soil and the uredo outbreak is based upon vigor. In seasons of drought plants become very much weakened, hence they become infected; while those plants grown in neighboring towns, which are characterized by much heavier soil, never have anything but the teleuto spore stage occurring in September or October. The teleuto spore stage appears to be widely distributed in the State, and has been so from the very first. The question naturally arises, Why do these teleuto spore infected beds not have a summer stage? There are certainly plenty of beds which do not have it, and their distribution is wide. All the theories relating to the influence of such factors as dew, elevation, points of compass, shelter, utterly fail to account for a lack of uredo spore infection on these beds. The principal and most important difference found in these beds which are subject to the summer and fall infection is the one of soil texture and water-retaining capacity, which enables the plants,

other conditions being equal, to remain vigorous during seasons of drought. When the asparagus rust first made its appearance, there could be seen beds in which one portion was infected, while the other showed not the slightest trace of disease. The only differences existing in the plants were in their age and treatment. The differences of infection in these cases were due to different degrees of vigor. But such beds, being in regions where the soil is very sandy, subsequently became rusted. One bed on the college ground has had the fall stage since 1896, it usually appearing between September 15 and October 1. It has, however, never shown any trace of the rust in summer, or previous to September. Other beds, both young and old, situated close by, have been entirely free at times, and only insignificant teleuto spore pustules have been found on them very late in the fall. All the beds are situated on soils possessing high water-retaining properties, as well as an abundant supply of water from below.

Some attention was given to the rust problem by this division during the summer, and many localities have been examined. We have also, as usual, sent out a series of circulars, asking for information on certain points. Among other questions asked were those relating to the effect of dew, elevation and shelter from tree growths, etc., on infection. Not a single instance has been brought to our attention where the shelter produced by forest growths or crops has exerted any influence. As to the effect of elevation, considerable differences have always been observed by us in the amount of rust on a single bed, and such instances have been reported by asparagus growers in their correspondence. Where a bed runs down a little elevation, and where there are more moisture and organic matter contained in the soil, the plants are larger, more luxuriant, and there is less infection. No grower has been able to give us the slightest hint that plants are prone to show more infection in regions that are subject to dews. Since there is likely to be more dew deposited on the lower part of a bed than on the upper part of it, and if this factor is alone responsible for infection, we would expect to find more rust on those plants grown on the low portions of the bed than on the upper part. This is,

however, as we have stated, not borne out by our observations; on the other hand, the reverse is true. In general, elevation is connected with dew only in a relative sense, inasmuch as a location 300 feet above the sea may be subject to less dew than one 600 feet in height. And it is not to be presumed, as one writer has inferred, that the elevation above the sea level necessarily indicates in every instance the amount of dew which ought to be present there; in other words, local conditions affect the amount of dew. On Long Island it is reported that the lower beds rust first, and then those on higher elevations. It may be perfectly true that this takes place in that region and on those soils, although no such instance has come to our knowledge in this State. When plants are not resistant enough to stand uredo spore infection it is not difficult to understand how this might take place; but the presence of any amount of dew fails to infect some beds in this State. The principal bed on the college grounds is located near a pond, and only a few feet above it. If the effect of dew constitutes an important factor for uredo spore infection, then it would seem as if this bed ought to show it, but fortunately it never has.

There is evidence, however, that dew plays an important part in asparagus rust infection in those regions where all of the conditions are favorable for uredo spore outbreak; or, in other words, there are local conditions that exert an influence; but it appears to exert no such influence so far in those beds which show resistance enough to overcome the uredo stage. We have repeatedly seen plants grown under trees, or in any place where they were shaded by some covering, that scarcely showed the rust, whereas those plants just outside of the covering of the limbs, etc., might be badly affected. Our attention has been repeatedly called to this peculiarity by correspondence with asparagus growers, and this freedom from susceptibility in such local instances is undoubtedly caused by the absence of dew. These facts suggest a possible remedy for the rust,—at least in the starting of young plants. The young plants rust much more easily than the old ones; they are much more severely injured, and are a constant source of contamination. If

these can be started under cheese cloth covers, such as are now being so extensively used by tobacco growers in the Connecticut valley, it would certainly be an advantage to get such plants started before setting them out into permanent beds; and it would seem that the covering of cheese cloth would be as effectual as the tree covering in keeping off the dew, thus rendering them less susceptible to rust. Some asparagus growers have already considered this method of cultivation.

Experiments in spraying with the formula recommended by the Geneva station were tried during the past summer. This spraying was not done so often or so thoroughly as it could be done with the apparatus recommended for this work. At the close of the season the results of the applications were readily discernible, in the greener color and more vigorous shoots of the treated plants. This method is a costly one to apply, on account of its requiring a special apparatus and a fungicide which is difficult to prepare; thus asparagus growers do not take to it at present.

Fully as favorable results in one instance were obtained by the application of Paris green to a young bed. In this instance a large bed was treated twice for beetles during the summer. About August 18 the uredo stage of the rust commenced to show somewhat on the plants, and at this time one-half of the bed was treated with Paris green early in the morning, when the plants were covered with dew. This treatment seemed to arrest the outbreak of the rust to quite a remarkable extent. This method of treating is a very cheap one, as Paris green is not expensive, and the ease with which it can be put on makes the application far less expensive than by spraying with certain other fungicides. These plants were evidently treated just in the right time to be effective. From the results obtained, it would be worth while to give this method of treatment further trial. It is expected, however, that some experiments along other lines than those heretofore conducted will be tried next year, from which it is hoped that some results of importance will be obtained.

STERILIZATION OF SOIL IN GREENHOUSES FOR FUNGUS DISEASES.

This method of treating soil infected with disease-producing organisms or germs has been frequently dealt with in the publications of this division and elsewhere. We have recommended this method for the extermination of such fungous pests in the soil as cause the drop in lettuce and other plants, the timber rot in cucumbers, the *Rhizoctonia* and damping fungus (*Pythium De Baryanum*), and in part the stem rot in carnations. It has also been recommended for nematode worms, diseases caused by *Heterodera*, which affect indoor cucumbers, tomatoes, roses, violets, cyclamens, muskmelons and other greenhouse plants, and for the aphid and red spider. It is also effective in the destruction of weed seeds. One lettuce grower maintained that it paid to sterilize soil for this purpose alone. Heating of the soil greatly accelerates the growth of plants, and when this method of treatment is applied to lettuce houses affected with the drop and *Rhizoctonia*, it successfully eliminates these diseases, which are all a skilful grower needs concern himself about. This method of treatment has not been recommended for such diseases as top-burn, mildew of lettuce, nor for the damping fungus (*Botrytis*) in propagating pits, or for any other fungi giving rise to diseases which are freely disseminated by spores. Neither does this method, as ordinarily applied, succeed in accomplishing absolute sterilization of the soil. It is merely a sort of pasteurization. Cultures of the soil heated to 212° F. for a short time would show numerous bacteria, and myriads of others subsequently come in from the air and through the water applied to the soil.

The last year has seen quite remarkable strides made in the practice of methods of ridding the soil of parasitic organisms by means of heat. On account of the extensive use of the sterilization method on a large scale by the most efficient and practical gardeners, the process has been made very much cheaper, and hastened to a large degree. At the present time whole ranges of greenhouses owned by single

individuals, representing in some cases some acres, are now sterilized, and the method has been employed out of doors to some extent. Many of the houses treated are 300 or more feet in length and from 40 to 50 feet wide. Some market gardeners have practised sterilization of their houses for three years: not, however, for the sole purpose of ridding the soil of certain disease-producing organisms, as that could be accomplished by one treatment when properly done, but largely for the purpose of increasing their crops. A great many experiments have been made by this division during the last six years on various crops, in which the growth of plants in sterilized soil was compared with the growth of the same species of plants in precisely similar earth not sterilized. The effect of sterilization is quite marked in such experiments. W. W. Rawson, one of our largest lettuce growers in the State, who has observed the effect of sterilization on his own crops for two or three years, declared that he would rather have one inch of sterilized soil on his beds than any fertilizer which he had ever tried. For the purpose of determining, on a larger scale than we had heretofore shown, the effect heating the soil had upon the acceleration of a crop of lettuce, we made the following experiment in one of our houses:—

Two beds of nearly equal size were chosen, one of which was treated with hot water until the soil was soaked, and which showed an average temperature of 145° F. at the depth of 4 inches below the surface. The seed and prickers were also planted in boxes of earth which had been heated to 212° F. with steam. The other bed remained untreated, and likewise the soil in which the seed and prickers were started. Other than the hot water treatment given to the previously described bed, no perceptible difference existed. The number of plants in the treated bed was 308: the number in the untreated bed was 264. The results, however, were very marked, as shown below:—

Table showing Difference in Lettuce Plants grown in Sterilized and Unsterilized Soil.

| | Plants in Untreated Soil. | Plants in Treated Soil. | Per Cent. of Gain. |
|---|------------------------------|----------------------------|-----------------------|
| Average weight of largest plants (grams), . | 137.5 | 206.6 | 33 |
| Average weight of typical plants (grams), . | 56.2 | 86.3 | 33 |
| Excess of water in treated plants over that of untreated. | - | - | 2.2 |

The average weight of the largest plants represented that taken from four specimens selected from each bed in corresponding rows and close proximity. The four typical plants from each bed were selected at random, and they happen to show the same relative weight to each other as the largest ones do. The weights were all taken when the crop was four weeks along in the house and the treated ones were nearly ready for marketing. The plants were selected and weighed, and the amount of water determined in each lot, by Mr. A. L. Dacy, a student of the present senior class, who had charge of the house and who was quite familiar with the crop. The per cent. gain by starting the seed in sterilized soil and also transplanting the prickles in similarly treated soil, then transplanting into soil treated with hot water, was 33 per cent., which is a fair average increase due to this method of treatment.

The writer has made comparisons of lettuce plants grown in a rather poor quality of soil, one lot being sterilized and the other treated with the best possible combination of commercial fertilizers, with the result that the sterilized plants compare most favorably with those treated with fertilizers. This does not imply that sterilization will necessarily dispense with the use of fertilizers in the lettuce crop, if one wishes to apply them; as a matter of fact, however, they are seldom employed. The lettuce plant requires an exceedingly large amount of organic matter in the soil, and for this reason a generous supply of well-rotted horse manure is continually employed, for the double purpose of supplying organic matter and plant food. Plants

grown in sterilized soil are always lighter colored and more tender, and it is not a difficult task for an expert to pick out such plants in the market. Neither is it difficult to ascertain, from market specimens, to about what temperature lettuce plants have been subjected. In this respect the differences in plants are marked in a house where the soil has been treated twice as long in one place as in another. A gardener can readily pick out such places. It will be noticed in the table that there is 2.2 per cent. more water in the plants grown in the treated soil than in the untreated soil, and also that there is a corresponding decrease in the unburned residue which represents the organic matter, ash, constituents, etc. From the color and texture of lettuce grown in sterilized soil, this might be expected. The differences as shown in the above figures only represent one analysis.

The effect of sterilization on the soil is well illustrated in the case of a market gardener who picked 31,060 No. 1 cucumbers from 300 plants. The plants of this crop were carried through in treated soil from the beginning, *i.e.*, the seeds were sown in sterilized soil, and the various transplantings were made under similar treatment: The crop was grown after lettuce in the spring, when, it is true, cucumber vines bear heavily. Nevertheless, this was a phenomenal crop at any season of the year, and one which I have never seen equalled. Some allowance must be made in the size of this crop for the strain of cucumbers cultivated, which was a carefully selected stock of heavy bearers. Cucumber plants, nevertheless, respond quite remarkably to the influence of treated soil.

A number of methods of treating soil with heat have been employed by practical greenhouse men, and many experiments on different methods have been made by this division during the last few years. We have been able to observe the efficiency and practical utility of these various methods, and have reported on them at different times. The method of treating the soil by steam to the distance of one foot or more in depth has always appeared to us as the best one to be employed, and, since the cost of such treatment has been

greatly reduced of late, there appears to be no longer any reason why it can not be extensively used to eradicate diseases in those cases where there seems to be urgent need. The cost of treatment in badly infested houses proves an excellent financial investment. For example, some houses have had the drop in them to such an extent that 50 per cent. of the plants would succumb, and in some rare cases the whole crop has been lost. In a house containing 4,000 dozen plants at 50* cents per dozen the value of the crop would be \$2,000; or, at 25 cents per dozen, \$1,000. A loss of 50 per cent. would reduce the value of the crop to \$1,000 and \$500 respectively. Such a loss is the more provoking, inasmuch as the maximum amount of the drop occurs just about the time when the plants are mature, and all the labor bestowed on the crop in transplanting, the care given to the same, amount of heat utilized and valuable space which they have taken up, are all for nothing.

A house of this description was sterilized during the past winter at a cost of \$100, and in examining this crop, which was one of the most perfect we have ever seen, there was only one case of disease in the whole house. This one diseased plant occurred near an iron post that supported the house, and there was evidently a small portion of soil in that spot which had not been sufficiently treated. The cost of treating this small neglected area would, however, have been very insignificant. When we observed the crop, it had already been mature for nearly two weeks, and was being held back for a better market, which gave an excellent opportunity for any further drop to develop, if the germs were present. There appears to be no reason why, if a house is once treated as thoroughly as this house was, another treatment should be required for some years, providing care is taken to prevent contamination from old refuse material which contains the drop fungus. By allowing a few contaminated areas to exist in the soil, as a result of imperfect treatment, it would probably be from three to five years before the loss would reach that amount when it would be

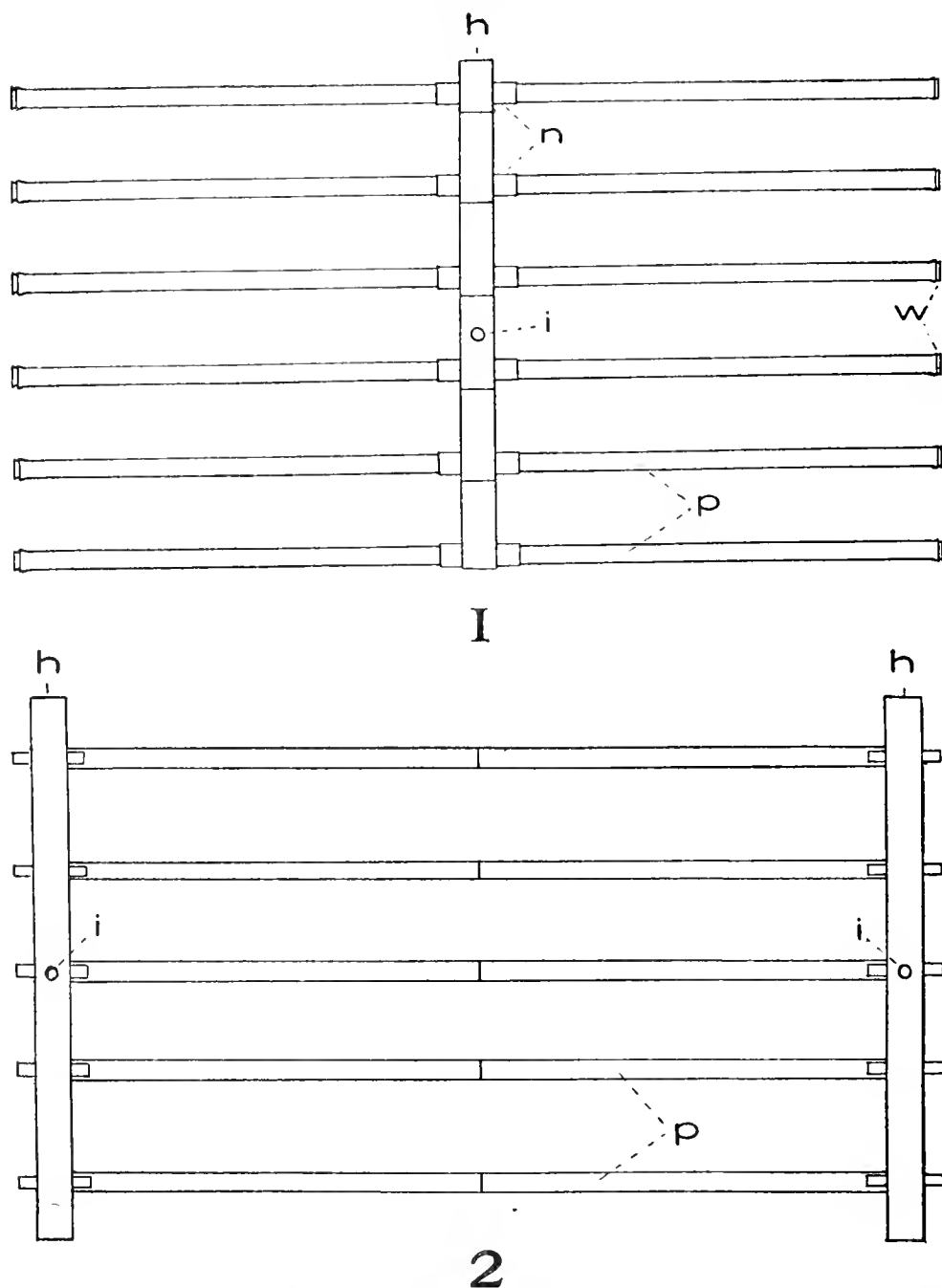
* At the present time, December, 1901, a neighboring market gardener is disposing of his lettuce at 65 cents per dozen.

necessary to treat the soil again. It requires no argument to show that the expense of \$100 for treatment of the house that would be worth \$2,000 at 50 cents per dozen, or even \$1,000 at 25 cents per dozen, is a good investment, even if the treatment has to be repeated each year. On the basis of a five-year treatment, which is, in our own estimation, all that is required, the gain is nearly five times as great. The increased value to the soil resulting from such treatment, and the possibility of having less weeds and fewer aphids, should also be taken into consideration in estimating the benefits derived from the use of this method. The oldest, most conservative and intelligent lettuce growers were enthusiastic over the results of this experiment.

Methods of Sterilizing. — The methods employed for heating the soil have been by either hot water or steam, with some variation in the mode of applying the latter. Messrs. Hittenger Bros. of Belmont have made extensive use of the hot-water method, and their later constructed houses have special facilities for applying this in the most economic manner. The hot-water method requires the treatment of the soil previous to the putting in of each crop, and only a few inches of the surface soil are sufficiently heated by this practice to kill the mycelium of the drop fungus.

The heating by steam is now done largely by the aid of perforated pipe, and in some cases use is made of 2 inch porous tile, though this method is not so applicable. If finely perforated tiles could be obtained in the market at a reasonable cost, their use would be much more valuable for this purpose than at present. The various contrivances are made out of perforated pipe, varying from 1 inch to 3 inches in diameter, usually placed from 7 to 12 inches apart, and made up into frames from 10 to 20 feet or more in length and into any desired width. The size and number of the perforations vary much in different appliances. When they are rather large ($\frac{1}{4}$ inch in diameter) they are frequently covered with burlap. In some appliances the perforations are $\frac{1}{4}$ inch in diameter and are only $1\frac{1}{2}$ inches apart each way. In others the perforations may be only $\frac{1}{8}$ inch in

diameter and from 3 to 6 inches apart, with two or three rows of such holes extending around the circumference of the pipe. Some of these appliances are not made up into



FIGS. 1 AND 2. — Showing types of sterilization apparatus: *h*, header; *n*, nipple; *w*, wooden plug; *i*, steam inlet; *p*, pipes. Both appliances are 20 feet long and about 8 feet wide.

permanent frames, but are in sections, easily put together or taken apart, and so constructed that they can be readily extended into any length or width desired. These frames are provided with headers placed transversely, which are pipes of larger diameter, containing perforations, and nipples are

inserted at intervals which readily fit into the extension pipes (see Figs. 1 and 2). In some instances the headers are placed at each end, thus forming with the extension pipes a frame composed of a series of rectangles (Fig. 2). In this form a complete circulation of the steam can take place. In others the headers are in the middle, and the extension pipes lead off in opposite directions (Fig. 1). In the latter case the ends of the extension pipe are plugged with wood, and a complete circulation of steam does not occur. The material most frequently used is iron pipe. The form devised by Mr. Cartter is constructed out of perforated galvanized-iron tubes, and is very light and easy to handle.

The method generally adopted by lettuce growers in heating their soils is to place the apparatus on the surface of the bed. If the bed is 20 feet wide, then it will be most convenient to have the heating appliance about 10 feet wide and 20 to 30 feet long. This is placed midway between the edges of the bed, and the soil to the depth of 1 foot is dug out on either side of the appliance and thrown on top of it.

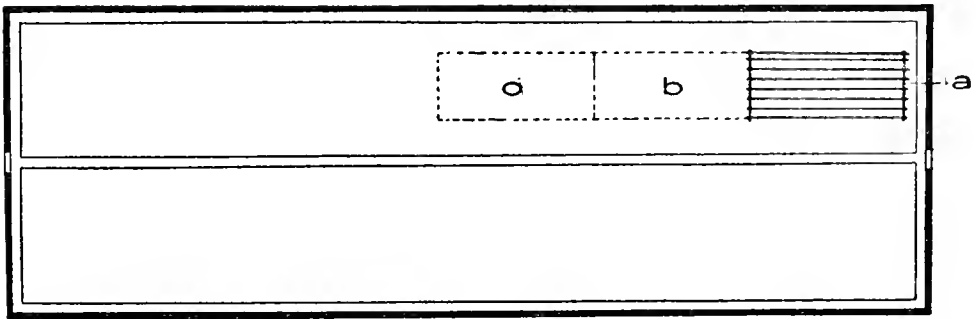


FIG. 3.—Plan of house, showing methods of sterilization: *b, c*, successive positions of the apparatus.

This covers the heating apparatus to a depth of 1 foot. The steam is now turned on and the soil heated. After sufficient steaming has taken place, the pipes can be pulled out and set up ready for the next treatment (see Fig. 3). The soil previously treated should be covered up with some old canvas, if available, or, in fact, with anything that will retain the heat, and allowed to stand some hours, after which the top portion is shovelled back to where it was taken from. Not only is the 1 foot of top soil heated by

this method, but the soil under which the apparatus rests is equally well done, provided too much haste is not made in removing the treated soil. In one case that was examined, where the steam was left on for one and one-half hours late in the afternoon, and the top coat of soil not disturbed until the next morning, we obtained the following records of soil temperatures at noon on the following day, or nineteen hours after the steam was applied and five hours after the top soil and apparatus had been removed: temperature of soil 2 feet below the surface, 120° F.; temperature of soil 1 foot below the surface, 175° F. Two masses of top soil were heated in this instance during the one and one-half hours, the last one being left on over night. The average pressure of steam applied was only 13 pounds. It always astonishes those who heat soil for the first time to find that steam can penetrate such a distance below the surface in so brief a period. In this particular case the steam was oozing out of the soil 30 inches below the surface, no examination below this depth being made. The most efficient appliances for sterilization are those based upon our recommendations in former publications. A 2 inch pipe is superior to a 1 inch, $1\frac{1}{4}$ inch or $1\frac{1}{2}$ inch pipe. A high pressure of steam is more effectual than a low pressure, and the larger the number of perforations in the pipe, the more widely and evenly is the steam disseminated and the more quickly and cheaply can the soil be heated. The area of a series of small holes placed uniformly in a given length of pipe would undoubtedly be more effectual than the same area of larger holes in the same length of pipe. In the latter case the holes would be further apart, and allow larger volumes of steam to escape; in the former case they would be nearer together, and would be capable of heating the soil more evenly and in our opinion more effectually. In our judgment, holes $\frac{1}{8}$ inch in diameter, when placed near together, would be sufficient for the exit of steam, and the soil would be less likely to go through them than through holes $\frac{1}{4}$ inch in diameter.

In proportion as the appliances have been improved for sterilizing soils, the cost of the operation has been greatly reduced. From reliable estimates which we have been able

to obtain from practical lettuce growers and others who have heated their soil, the cost, including coal, labor, etc., but not the cost of the tile or apparatus used, is as follows:—

In a house 225 feet long by 20 feet wide, one-third of which was heated at a time by steam passing through 2 inch tile placed 8 inches below the surface and 1 foot apart, and forming a continuous circuit, the cost was at the rate of \$16 per 1,000 cubic feet, where the pressure of steam used varied from 30 to 80 pounds. This house had been previously sterilized by the same method, excepting that the tiles were placed 18 inches apart, instead of 1 foot, with less favorable results. The heating was continued day and night, as this could be easily done, on account of a night foreman being employed. The estimated cost of removing the soil from a house to the depth of 1 foot, which was actually done in a similar house a few years ago, and placing in new soil without carting the same, was at the rate of \$37.50 per 1,000 cubic feet.

Another house, 40 feet wide by 300 feet long, was treated by a lettuce grower with an average pressure of 30 pounds of steam passed through 1 inch iron pipes, furnished with a series of perforations 6 inches apart and $\frac{3}{16}$ inches in diameter. These pipes were made up into a frame, 7 inches distant from one another. The estimated cost of sterilizing 1,000 cubic feet of soil, based upon the treatment of the whole house, was \$8.33.

A lettuce grower who has a range of houses each about 300 feet long by 36 feet wide has recently treated them all by steam. A boiler house, situated at the most convenient place on the establishment, was constructed, and a new forty horse-power boiler was placed in it, to be used exclusively for the purpose of sterilization. The sterilizing apparatus consisted of a series of 3 inch T's, furnished with 2 inch nipples, which was placed in the centre of the apparatus, thus forming a header. From these nipples there extended in each direction a series of perforated 2 inch iron pipes which were 10 feet in length (see Fig. 2). This made the apparatus when complete about 20 feet long and 8 feet wide. The apparatus was placed on the surface of the soil, the ends of the pipe stopped up with wooden plugs, and the earth

from each side to the depth of 1 foot or more was placed upon it. The cost of this appliance was about \$20, though Mr. C. R. Learned, who devised it, thinks that he could make a duplicate of it for about \$17. It took three days to treat a house 300 feet long and 36 feet wide, and, from the estimated cost of labor, fuel, etc., the treatment was made at the rate of \$5.92 per 1,000 cubic feet. This work was done in the summer, when labor was probably more expensive than it would be in winter. Mr. Learned informs me that he expects better results the next time.

A sterilizing machine used by Mr. Cartter is made of 2 inch galvanized-iron tubing, of 20 ply, with $\frac{3}{16}$ or $\frac{1}{4}$ inch holes, 1 inch apart each way. The headers are 2 to 3 feet long and 3 inches in diameter, and are made up of the same material and perforated in like manner. Galvanized-iron nipples are soldered on both sides of the headers, 8 inches apart. The ends of the 10-foot length pipes are made to fit on to the nipples and also into one another, so that any desired length or width of appliance can be obtained (Fig. 1). This apparatus contains more perforations to the linear foot than any we have seen, and for this reason, and owing to the diameter of the tubing used, it is the most effectual as a heater. We observed one test with this apparatus in which 400 cubic feet of soil were treated at the rate of \$2 per 1,000 cubic feet. This includes the cost of labor at 10 cents per hour, which was required to place the apparatus in position and cover it with soil ready for use, and replace the same when heated; also the amount of fuel burned during the treatment, together with the amount of coal it required to bring the same amount of water in the boiler to the same degree of temperature, and the steam to the same pressure as before the treatment was started. Whether this rate of sterilization by the use of this apparatus is actually attained when applied on a large scale, we have not learned.

When soil can be sterilized at \$2 per 1,000 cubic feet, or even at \$5, there is no longer any question concerning the practical application of this method to rid greenhouses of some of its worst enemies, which interfere with the produc-

tion of healthy and profitable crops. Even when the cumbersome tile method is employed, the cost of sterilization is less than one-half the cost of removing the old soil from a house and supplying it with new. So universal is this method of treating greenhouses devoted to lettuce, cucumbers, and in some cases to those devoted to violets, carnations, chrysanthemums and roses, that we are unable to give at the present time the number of acres which have been and are being treated. The method, we are told, is to be tried on onions next season grown out of doors. It has already been utilized in the culture of out-door lettuce and celery to a small extent, and tobacco growers are beginning to use sterilized soil in which to start their seedlings. We understand that it costs \$65 to weed an onion bed of one acre in extent. It remains to be seen whether the weeds can be eliminated by the use of steam for a less price, to make it an object to use it. Such a treatment would certainly be of great value in the control of smut.

It is not the object of this division to recommend this method too enthusiastically or as a cure for all difficulties. On the other hand, we are desirous of seeing the method tried wherever there is reasonable possibility of its success. In the mean time, we prefer to see the method developed as it is now being done, by practical men who have to reckon with the question of dollars and cents, for, after all, they are the ones who must render the final judgment on any process of treatment. Our facilities have not been sufficient to test this sterilization method on a large scale, neither are we confronted with the economic conditions which commercial men have. For these reasons we have drawn quite extensively on the results obtained by practical men, who apply the method on a large basis, rather than on our own experiments, in discussing this subject at this time.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD, H. T. FERNALD

The work of the entomological division of the experiment station during the past year has followed the lines of previous reports. The amount of correspondence has been much larger than ever before, being due in a great measure to the appearance of the elm-leaf beetle in the eastern portion of the State in such numbers as to do great damage, and also as an indirect result of the appointment of tree wardens. These officials in the course of their duties have watched the trees and the insects upon them closely, and have frequently communicated with the station concerning their observations. Correspondence of this kind has increased nearly ten per cent. over that of former years, which is of itself a testimonial of the value and success of the tree warden law.

The entire edition of a former publication of the station upon the elm-leaf beetle having become exhausted, a new bulletin on this insect was prepared and published during the summer. This was the only paper from the entomological division published by the station, but others were prepared by the division and published during the year by the secretary of the Board of Agriculture of Massachusetts. The most important of these was a paper on "Three common orchard scales," with figures and half-tones, published in the Crop Report for May, 1901, and which has been in much demand.

The station was represented at the meeting of the Official Horticultural Inspectors of the United States, held at Washington, Nov. 11-13, 1901. At this meeting much uniformity of practice among the nursery inspectors of the different States was established and many results of value obtained.

Nursery inspection for Massachusetts is one of the duties of the entomological division of the station, and requires a total of two or three weeks' time each year. The results of this work are of direct value to the nurserymen only, but in an indirect way lead not only to a more careful watch of the nurseries by their owners, but to the utilization of the facilities of the experiment station as a place of inquiry and reference on subjects connected with insects and plant disease, thus bringing the station into touch with an occupation where its services are of great value.

INSECTS OF THE YEAR.

The year has not been marked by the unusual abundance of any particular insect, except, perhaps, the elm-leaf beetle in the eastern part of the State. This insect has been injuriously abundant in the Connecticut valley for a number of years, but has failed to make its presence felt in the more eastern cities and towns until recently. During the past summer, however, it has made havoc with the foliage of the elms in hundreds of places, and caused a large amount of correspondence with this division, while much of what has been published in the newspapers concerning this insect consisted of remedies and methods of treatment which were inefficient or utterly worthless.

The brown-tail moth has increased in abundance, and in the area which it occupies, until it is probably present in more than twelve hundred square miles in this State, and has extended into Maine and New Hampshire. While in some ways it is an easy insect to control, the assurance that no concerted action will ever be taken by all those persons on whose trees it is present renders it certain that it will remain an important pest; while the serious nature of the irritation caused by the spines of the caterpillars when they touch man has already been a source of much discomfort in the localities where it is most abundant.

The gypsy moth has reappeared at those points in the State where the work of the gypsy moth committee was unfinished when its functions were ended two years ago. It is but a question of time when the area from which it had then been exterminated will become reinfested. The entire

responsibility for this unfortunate state of affairs rests upon the Legislature, which discontinued the work of the commission, thereby deliberately wasting all the money previously expended.

The birch *Bucculatrix* has been in evidence during the past year, but, as was predicted in last year's report, has been most abundant in the northern and eastern portions of the State, where little had been seen of it before.

The San José scale has spread rapidly during the year, and is now known to occur in fifty-two localities in Massachusetts. It is not only present in nurseries and orchards, but in several instances it is generally present over areas of several miles. In one place—a residential suburb—nearly every deciduous tree and shrub within an area of five square miles is infested, and many of the plants are already dead, while others are dying. During the summer the scale was found generally distributed through the orchard of the Massachusetts Agricultural College, which consists of over a thousand trees. The origin, distribution and present conditions in this case have been carefully studied, and a special report on the subject has been transmitted to the trustees.

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

The work of the meteorological division during the past year has been confined almost entirely to the observation of the various weather phenomena, the tabulation of the data obtained and the computation of the daily and monthly means of the several weather elements. The records of each month are compared with the normals of the ten-year period, 1889-99, and the more important departures from mean conditions obtained.

At the beginning of each month a summary of the weather of the preceding month has been prepared and published as a four-page bulletin. On the inside pages are given a number of the daily means, some of the more important maxima and minima daily records, together with data of the winds and amount of precipitation. On the outside pages a summary of the various weather elements with the monthly means is given, as well as general remarks on the weather for the month. The usual annual summary will be prepared and published with the December bulletin.

The local forecasts for the weather for the following day have been furnished daily, except Sunday, by the New England section of the United States Weather Bureau. In accordance with these predictions, the proper weather flags have been displayed from the flag staff on the tower. At the request of the section director, the weekly snow reports are being sent to the Boston office this season, as heretofore.

Owing to the failure during the past few years to get satisfactory results with our electrical apparatus for the determination of soil moisture, these observations were discontinued this year. This work will be resumed whenever more improved apparatus can be obtained.

The monthly observations of the declination of the magnetic needle, begun last year, have been continued. The results obtained the latter part of the year have not been very satisfactory, probably due to local attraction caused by the line of steam pipe to the drill hall. By changing the true meridian to another location it is expected to remedy this.

No new equipment has been added during the year, but a three years' supply of charts for the Draper instruments has recently been purchased.

At the opening of the college, in September, Mr. C. L. Rice, the observer, retired from the division, and was succeeded by the assistant observer, Mr. H. L. Bodfish.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.

Assistants: HENRI D. HASKINS, SAMUEL W. WILEY, JAMES E. HALLIGAN.

PART I. — Report on Official Inspection of Commercial Fertilizers.

PART II. — Report on General Work in the Chemical Laboratory.

PART III. — Compilation of Analyses of Agricultural Chemicals, Refuse Salts, Ashes, Lime Compounds, Refuse Substances, Guanos, Phosphates and Animal Excrements.

PART IV. — Compilation of Analyses of Fruits, Garden Crops and Insecticides.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS DURING THE SEASON OF 1901.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 61; of these, 37 have offices for the general distribution of their goods in Massachusetts, 8 in New York, 7 in Connecticut, 3 in Vermont, 1 in Rhode Island, 2 in Canada, 1 in New Jersey and 1 in Maryland.

Two hundred and sixty-six brands of fertilizer, including chemicals, have been licensed in the State during the year.

Four hundred and forty-nine samples of fertilizers have thus far been collected in the general markets by experienced assistants in the station.

Three hundred and seventy-one samples were analyzed at the close of November, 1901, representing 230 distinct brands of fertilizer. These analyses were published in two bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 75, July; and No. 77, November, 1901.

As in previous years, the samples of licensed fertilizers which have not been already analyzed, together with other samples that may be collected, will be analyzed for publication in our March bulletin, 1902. (This includes several samples forwarded by manufacturers at the inspector's request, which were not found in the general markets by our collectors. All such samples are certified by the manufacturers as being an impartial representative of the brands in question.)

For the readers' benefit, the following abstract of the results of our analysis is here inserted:—

| | 1900. | 1901. |
|--|-------|-------|
| <i>(a)</i> Where three essential elements of plant food were guaranteed:— | | |
| Number with three elements equal to or above the highest guarantee, | 15 | 7 |
| Number with two elements above the highest guarantee, | 24 | 15 |
| Number with one element above the highest guarantee, | 85 | 51 |
| Number with three elements between the lowest and highest guarantee, | 118 | 142 |
| Number with two elements between the lowest and highest guarantee, | 92 | 91 |
| Number with one element between the lowest and highest guarantee, | 43 | 39 |
| Number with three elements below the lowest guarantee, | 1 | — |
| Number with two elements below the lowest guarantee, | 11 | 8 |
| Number with one element below the lowest guarantee, | 50 | 86 |
| <i>(b)</i> Where two essential elements of plant food were guaranteed:— | | |
| Number with two elements above the highest guarantee, | 5 | 7 |
| Number with one element above the highest guarantee, | 20 | 12 |
| Number with two elements between the lowest and highest guarantee, | 19 | 24 |
| Number with one element between the lowest and highest guarantee, | 6 | 14 |
| Number with two elements below the lowest guarantee, | — | 2 |
| Number with one element below the lowest guarantee, | 20 | 14 |
| <i>(c)</i> Where one essential element of plant food was guaranteed:— | | |
| Number above the highest guarantee, | 15 | 7 |
| Number between lowest and highest guarantee, | 9 | 18 |
| Number below lowest guarantee, | 10 | 9 |

A comparison of the above-stated results of our inspection with the results of the previous year shows that the manufacturer's standard or guarantee has been as well maintained as in the past; and in nearly all cases where a discrepancy has occurred between the results of analysis and the manufacturer's guarantee, the commercial value of the article has not suffered, the low percentage of one element of plant food having been balanced by a correspondingly high percentage of some one of the other ingredients.

The fertilizer bulletins become of the utmost value when considered from the stand-point of a source of intelligence to the farmer to select his fertilizer for the next year's consumption.

In deciding what brands of commercial fertilizer to purchase for general use, select the one that will furnish the greatest amount of nitrogen, potash and phosphoric acid, in a suitable and available form, for the same money.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1900 and 1901 (Cents per Pound).

| | 1900. | 1901. |
|--|-------|-------|
| Nitrogen in ammonia salts, | 17.00 | 16.50 |
| Nitrogen in nitrates, | 13.50 | 14.00 |
| Organic nitrogen in dry and fine-ground fish, meat, blood and in high-grade mixed fertilizers. | 15.50 | 16.00 |
| Organic nitrogen in fine bone and tankage, | 15.50 | 16.00 |
| Organic nitrogen in medium bone and tankage, | 11.00 | 12.00 |
| Phosphoric acid soluble in water, | 4.50 | 5.00 |
| Phosphoric acid soluble in ammonium citrate, | 4.00 | 4.50 |
| Phosphoric acid in fine-ground fish, bone and tankage, | 4.00 | 4.00 |
| Phosphoric acid in cotton-seed meal, castor pomace and wood ashes, | 4.00 | 4.00 |
| Phosphoric acid in coarse fish, bone and tankage, | 3.00 | 3.00 |
| Phosphoric acid insoluble (in water and in ammonium citrate) in mixed fertilizers. | 2.00 | 2.00 |
| Potash as sulfate (free from chlorides), | 5.00 | 5.00 |
| Potash as muriate, | 4.25 | 4.25 |

A comparison of the above trade values for 1900 and 1901 shows a somewhat higher cost of organic nitrogen and nitrogen in form of nitrates, and a corresponding decrease in the cost of ammonia salts. Phosphoric acid soluble in water

was given a half cent higher valuation than in the previous year.

The above trade values are, as in years past, based on the market cost, during the six months preceding March, 1901, of standard raw materials which enter largely into the manufacture of commercial fertilizers found in our markets. The following is a partial list of such materials : —

| | |
|---------------------|---------------------------------|
| Sulfate of ammonia. | Dissolved bones. |
| Azotine. | Acid phosphate. |
| Cotton-seed meal. | Refuse bone-black. |
| Linseed meal. | Ground phosphate rock. |
| Bone and tankage. | High-grade sulfate of potash. |
| Nitrate of soda. | Sulfate of potash and magnesia. |
| Dried blood. | Muriate of potash. |
| Castor pomace. | Kainit. |
| Dry ground fish. | Sylvinite. |
| Dry ground meat. | Crude saltpetre. |

In order to use the table of trade values in calculating the approximate value of a fertilizer, calculate the value of each of the three essential elements of plant food — nitrogen, phosphoric acid and potassium oxide (including the different forms of each wherever different forms are recognized in the table) — in one hundred pounds of the fertilizer, and multiply each product by twenty, to raise it to a ton basis. The sum of these values will give the total value of the fertilizer per ton at the principal places of distribution. An example will suffice to show how this calculation is made : —

Analysis of Fertilizer (Per Cent., or Pounds in One Hundred Pounds of Fertilizer).

| | |
|---|----|
| Nitrogen, | 4 |
| Soluble phosphoric acid, | 8 |
| Reverted phosphoric acid, | 4 |
| Insoluble phosphoric acid, | 2 |
| Potassium oxide (as sulfate), | 10 |

| | Value per Hundred Pounds. | Value per Ton (Two Thou- sand Pounds). |
|---|---------------------------------|--|
| Four pounds nitrogen, at 16 cents, | \$0 64×20 | = \$12 80 |
| Eight pounds soluble phosphoric acid, at 5 cents, . . . | 40×20 | = 8 00 |
| Four pounds reverted phosphoric acid, at 4.5 cents, . . . | 18×20 | = 3 60 |
| Two pounds insoluble phosphoric acid, at 2 cents, . . . | 04×20 | = 80 |
| Ten pounds potassium oxide, at 5 cents, | 50×20 | = 10 00 |
| Value per ton, | | \$35 20 |

Table A gives the average analysis of officially collected fertilizers for 1901. Table B gives a compilation of analyses of commercial fertilizers for the year 1901, showing the maximum, minimum and average percentages of the different essential elements of plant food found in special crop fertilizers, so called.

TABLE B. — *Compilation of Analyses of Commercial Fertilizers for the Year 1901.*

| NAME OF FERTILIZER. | Analyses. | Moisture. | NITROGEN IN ONE HUNDRED POUNDS. | | | TOTAL PHOSPHORIC ACID IN ONE HUNDRED POUNDS. | | | AVAILABLE PHOSPHORIC ACID IN ONE HUNDRED POUNDS. | | | POTASSIUM OXIDE IN ONE HUNDRED POUNDS. | | |
|--------------------------------------|-----------|-----------|---------------------------------|----------|----------|--|----------|----------|--|----------|----------|--|----------|----------|
| | | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. |
| Corn fertilizer, | 17 | 11.52 | 5.11 | 1.00 | 2.59 | 14.51 | 9.62 | 11.53 | 9.67 | 5.40 | 8.23 | 9.94 | 1.72 | 4.02 |
| Fruit and vine fertilizer, | 4 | 8.11 | 3.24 | 2.06 | 2.38 | 13.64 | 8.11 | 10.89 | 8.98 | 4.63 | 6.76 | 10.52 | 5.14 | 7.40 |
| Grain fertilizer, | 13 | 10.00 | 9.09 | 1.19 | 3.44 | 17.99 | 6.17 | 12.18 | 11.28 | 4.74 | 8.65 | 13.62 | 2.16 | 5.73 |
| Grass fertilizer, | 15 | 8.77 | 5.47 | 1.19 | 3.80 | 17.99 | 6.17 | 10.45 | 10.75 | 5.07 | 7.05 | 13.62 | 2.22 | 5.47 |
| Market-garden fertilizer, | 16 | 10.82 | 4.85 | .97 | 3.15 | 13.33 | 6.17 | 10.38 | 10.90 | 5.07 | 8.06 | 11.42 | 2.33 | 6.27 |
| Potato fertilizer, | 39 | 11.03 | 5.44 | 1.22 | 2.63 | 13.74 | 7.37 | 10.73 | 10.80 | 4.00 | 8.03 | 10.00 | 2.30 | 5.63 |
| Tobacco fertilizer, | 10 | 8.84 | 6.36 | 1.16 | 4.07 | 13.25 | 4.35 | 9.21 | 11.41 | 3.48 | 7.27 | 17.70 | 3.34 | 8.62 |

From the great variations in the results of analyses of the above special crop fertilizers (see Table B) it will be readily observed that it will be unsafe to be guided by trade names wholly when selecting fertilizers for the growing of special crops.

Local conditions as to the character of the soil and sub-soil, the previous management of the soil and the system of crop rotation employed should all enter into consideration when selecting a fertilizer. A study of the soil should be made, to find in what direction the plant food has become depleted; and when these facts have become established, then supply the wants of the soil in the most suitable and economical manner. When the character of a soil is not known and its wants are not manifested, it is advisable to use a fertilizer more nearly corresponding to what a chemical analysis of the crop shows is required for its proper development.

An example is here inserted for the purpose of illustrating how the chemical composition of a crop may serve as a guide in the compounding of a commercial fertilizer, also to serve as an object lesson of how to intelligently use the compilation of analyses which is a part of the annual report of the chemical department for this year. We will take the average composition of cranberries, as this appears first in our table of compilation of fruits, etc.:—

Average Analysis of Cranberries.

| | Parts per Thousand. |
|----------------------------|---------------------|
| Phosphoric acid, | .30 |
| Potassium oxide, | 1.00 |
| Nitrogen, | .80 |

The relative proportion of phosphoric acid, potassium oxide and nitrogen present, according to this analysis, is:—

| | |
|----------------------------|------|
| Phosphoric acid, | 1.00 |
| Potassium oxide, | 3.33 |
| Nitrogen, | 2.66 |

In other words, for every pound of phosphoric acid removed from the soil by a crop of cranberries, there are 3.33 pounds of potassium oxide and 2.66 pounds of nitrogen re-

moved. A fertilizer supplying the essential elements of plant food in this proportion would, therefore, under the above-stated conditions, be more suitable to use.

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State during the Past Year (May 1, 1901, to May 1, 1902), and the Brands licensed by Each.

The American Agricultural Chemical Co., Boston, Mass. : —

Nitrate of Soda.
Muriate of Potash.
High-grade Sulfate of Potash.
Double Manure Salt.
Dry Ground Fish.
Fine-ground Bone.
Dissolved Bone-black.
Plain Superphosphate.
Dry Blood.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass. : —

Bradley's X. L. Superphosphate.
Bradley's Potato Manure.
Bradley's Potato Fertilizer.
Bradley's Complete Manure for Potatoes and Vegetables.
Bradley's Corn Phosphate.
Bradley's Eclipse Phosphate.
Bradley's Niagara Phosphate.
Bradley's English Lawn Fertilizer.
Bradley's Complete Manure with Ten Per Cent. Potash.
Bradley's Complete Manure for Corn and Grain.
Bradley's Complete Manure for Top-dressing.
Bradley's Grass and Lawn Top-dressing.
Breck's Lawn and Garden Dressing.
Brightman's Fish and Potash.
Church's Fish and Potash.
Grass and Grain.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass. : —

Clark's Cove Bay State Fertilizer.
Clark's Cove Bay State Fertilizer, G. G.
Clark's Cove Potato Manure.
Clark's Cove Potato Fertilizer.
Clark's Cove Great Planet Manure.
Clark's Cove King Philip Guano.
Clark's Cove Grass Fertilizer.

The American Agricultural Chemical Co. (Crocker Fertilizer and Chemical Co., branch), Buffalo, N. Y. : —

Crocker's Potato, Hop and Tobacco Phosphate.
Crocker's Corn Phosphate.
Crocker's New Rival Phosphate.
Crocker's General Crop Phosphate.
Crocker's A. A. Complete Manure.

The American Agricultural Chemical Co. (Cumberland Bone Phosphate Co., branch), Boston, Mass. : —

Cumberland Superphosphate.
Cumberland Potato Fertilizer.

The American Agricultural Chemical Co. (L. B. Darling Fertilizer Co., branch), Pawtucket, R. I. : —

Blood, Bone and Potash.
Potato and Root Crop Manure.
Complete Ten Per Cent. Manure.
Potato Manure.
Farm Favorite.
Animal Fertilizer.

The American Agricultural Chemical Co. (East India Chemical Works, branch), New York, N. Y. : —

East India Chemical Works' Complete Potato Manure.
East India Chemical Works' A. A. Phosphate.

The American Agricultural Chemical Co. (Great Eastern Fertilizer Co., branch), Rutland, Vt. : —

Northern Corn Special.
Grass and Oats Fertilizer.
General Fertilizer.
Garden Special.

The American Agricultural Chemical Co. (Pacific Guano Co., branch), Boston, Mass. : —

Pacific High-grade General.
Pacific Soluble Pacific Guano.
Pacific Potato Special.
Pacific Nobisque Guano.

The American Agricultural Chemical Co. (Packers' Union Fertilizer Co., branch), Rutland, Vt. :—
 Animal Corn Fertilizer.
 Potato Manure.
 Universal Fertilizer.
 Wheat, Oats and Clover Fertilizer.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass. :—

Quinnipiac Phosphate.
 Quinnipiac Potato Manure.
 Quinnipiac Corn Manure.
 Quinnipiac Market-garden Manure.
 Quinnipiac Grass Fertilizer.
 Quinnipiac Havanna Tobacco Fertilizer.
 Quinnipiac Climax Phosphate.
 Quinnipiac Potato Phosphate.
 Quinnipiac Special with Ten Per Cent. Potash.

The American Agricultural Chemical Co. (Read Fertilizer Co., branch), New York, N. Y. :—

Read's Farmers' Friend.
 Read's Practical Potato Special.
 Read's Bone, Fish and Potash.
 Read's Vegetable and Vine.
 Read's High-grade Farmers' Friend.
 Read's Standard.

The American Agricultural Chemical Co. (Standard Fertilizer Co., branch), Boston, Mass. :—

Standard Fertilizer.
 Standard Guano.
 Standard Complete Manure.
 Standard Special for Potatoes.

The American Agricultural Chemical Co. (Henry F. Tucker, branch), Boston, Mass. :—

Tucker's Original Bay State Bone Superphosphate.
 Tucker's Potato Fertilizer.
 Tucker's Imperial Bone Superphosphate.

The American Agricultural Chemical Co. (Williams & Clark Fertilizer Co., branch), Boston, Mass. :—

Williams & Clark's High-grade Special.
 Williams & Clark's Americans Phosphate.

The American Agricultural Chemical Co. — *Con.*

Williams & Clark's Potato Phosphate.
 Williams & Clark's Corn Phosphate.
 Williams & Clark's Potato Manure.
 Williams & Clark's Royal Bone Phosphate.
 Williams & Clark's Prolific Crop Producer.

The American Agricultural Chemical Co. (M. E. Wheeler & Co., branch), Rutland, Vt. :—

Corn Fertilizer.
 Potato Manure.
 Superior Truck Fertilizer.
 Bermuda Onion Grower.
 Grass and Oats Fertilizer.

Wm. H. Abbott, Holyoke, Mass. :—

Animal Fertilizer.
 Eagle Brand.
 Tobacco Fertilizer.

American Cotton Oil Co., New York, N. Y. :—

Cotton-seed Meal.
 Cotton-seed Hull Ashes.

Armour Fertilizer Works, Baltimore, Md. :—

Blood, Bone and Potash.
 Ammoniated Bone with Potash.
 Grain Grower.
 All Soluble.
 High-grade Potato.
 Bone Meal.

H. J. Baker & Bro., New York, N. Y. :—

Castor Pomace.

C. A. Bartlett, Worcester, Mass. :—

Fine-ground Bone.

Bartlett & Holmes, Springfield, Mass. :—

Animal Fertilizer.
 Pure Ground Bone.
 Tankage.

Berkshire Fertilizer Company, Bridgeport, Conn. :—


Berkshire Complete Fertilizer.
 Berkshire Ammoniated Bone Phosphate.
 Berkshire Potato Phosphate.

Joseph Breck & Sons, Boston, Mass. :—

Breck's Market Garden Manure.

Bowker Fertilizer Co., Boston, Mass.:—
 Stockbridge Special Manures
 Bowker's Hill and Drill Phosphate.
 Bowker's Farm and Garden Phosphate.
 Bowker's Lawn and Garden Dressing.
 Bowker's Potato and Vegetable Fertilizer.
 Bowker's Fish and Potash, "Square Brand."
 Bowker's Potato Phosphate.
 Bowker's Sure Crop Phosphate.
 Bowker's Market-garden Manure.
 Bowker's High-grade Fertilizer.
 Bowker's Bone and Wood Ash Fertilizer.
 Bowker's Tobacco Starter.
 Bowker's Potash or Staple Phosphate.
 Bowker's Ammoniated Dissolved Bone.
 Bowker's Superphosphate.
 Bowker's Ground Bone.
 Gloucester Fish and Potash.
 Dissolved Bone-black.
 Nitrate of Soda.
 Muriate of Potash.
 Sulfate of Potash-magnesia.
 Sulfate of Potash.
 Dried Blood.
 Tankage.
 Wood Ashes.

Butchers' Rendering Co., Fall River, Mass.:—
 Tankage.

E. Frank Coe Co., New York, N. Y.:—
 E. Frank Coe's High-grade Ammoniated Bone Superphosphate.
 E. Frank Coe's Gold Brand Excelsior Guano.
 E. Frank Coe's Tobacco and Onion Fertilizer.
 E. Frank Coe's Bay State Phosphate
 E. Frank Coe's  Fish and Potash.
 American Farmers' Market-garden Special.
 American Farmers' Complete Potato.
 American Farmers' Corn King.
 Farmers' Grass and Grain Fertilizer.
 Nitrate of Soda.

John C. Dow & Co., Boston, Mass.:—
 Dow's Ground Bone.

Eastern Chemical Co., Boston, Mass.:—
 Imperial Liquid Plant Food.
 Imperial Liquid Grass Fertilizer.

Wm. E. Fyfe & Co., Clinton, Mass.:—
 Canada Unleached Hard-wood Ashes.

Thomas Hersom & Co., New Bedford, Mass.:—
 Meat and Bone.
 Ground Bone.

F. E. Hancock, Walkerton, Ontario, Can.:—
 Pure Canada Unleached Hard-wood Ashes.

C. W. Hastings, Cambridgeport, Mass.:—
 Ferti Flora.

John Joynt, Lucknow, Can.:—
 Canada Hard-wood Ashes.

Thomas Kirley & Co.'s Fertilizer Works, South Hadley Falls, Mass.:—
 Pride of the Valley.

Lister's Agricultural Chemical Works, Newark, N. J.:—
 Lister's Success Fertilizer.
 Lister's Special Corn and Potato Fertilizer.
 Lister's High-grade Special for Spring Crops.
 Lister's Animal Bone and Potash.

Lowe Bros. & Co., Fitchburg, Mass.:—
 Tankage.

Lowell Fertilizer Co., Boston, Mass.:—
 Swift's Lowell Bone Fertilizer.
 Swift's Lowell Potato Phosphate.
 Swift's Lowell Market Garden.
 Swift's Lowell Tobacco Manure.
 Swift's Lowell Potato Manure.
 Swift's Lowell Animal Brand.
 Swift's Lowell Fruit and Vine.
 Swift's Lowell Dissolved Bone and Potash.
 Swift's Lowell Ground Bone.
 Nitrate of Soda.
 Muriate of Potash.
 Sulfate of Potash.
 Acid Phosphate.
 Tankage.

Mapes Formula and Peruvian Guano Co., New York, N. Y.:—

The Mapes' Bone Manures.
The Mapes' Superphosphates.
The Mapes' Special Crop Manures.
Tobacco Ash Constituents.
Tobacco Manure, Wrapper Brand.
Complete Manure with Ten Per Cent. Potash.
Economical Potato Manure.
Fruit and Vine Manure.
Dissolved Bone-black.
Nitrate of Soda.
Sulfate of Potash.

McQuade Bros., West Auburn, Mass.:—
Ground Bone.

Mitchell Fertilizer Co., Tremley, N. J.:—
Mitchell's Special Fertilizer.

Geo. L. Monroe, Oswego, N. Y.:—
Pure Canada Unleached Hard-wood Ashes.

National Fertilizer Co., Bridgeport, Conn.:—

Chittenden's Complete Fertilizer.
Chittenden's Market Garden.
Chittenden's Potato Phosphate.
Chittenden's Fish and Potash.
Chittenden's Ammoniated Bone.
Chittenden's Universal Phosphate.

New Bedford Product Co., New Bedford, Mass.:—
Complete Fertilizer.

New England Fertilizer Co., Boston, Mass.:—
Corn Fertilizer.
Potato Fertilizer.
High-grade Truck Fertilizer.

Olds & Whipple, Hartford, Conn.:—
Complete Tobacco Fertilizer.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.:—

Plymouth Rock Brand.
Special Potato.
Star Brand.
P. & P. Potato.
A. A. Brand.

Parmenter & Polsey Fertilizer Co.—*Con.*
Pure Ground Bone.
Nitrate of Soda.
Muriate of Potash.

Benjamin Randall, Boston, Mass.:—
Market Garden.
Farm and Field.

Rogers & Hubbard Co., Middletown, Conn.:—

Hubbard's Pure Raw Knuckle Bone Flour.
Hubbard's Strictly Pure Fine Bone.
Hubbard's Oats and Top-dressing.
Hubbard's Soluble Potato Manure.
Hubbard's Corn and General Crops.
Hubbard's Soluble Tobacco Manure.
Hubbard's Grass and Grain Fertilizer.
Hubbard's All Soils and All Crops Fertilizer.
Hubbard's Potato Phosphate.
Hubbard's Corn Phosphate.

Rogers Manufacturing Co., Rockfall, Conn.:—

All Around Fertilizer.
Complete Potato and Vegetable.
Complete Corn and Onion.
Complete Fish and Potash.
High-grade Grass and Grain.
High-grade Tobacco and Potato.
High-grade Oats and Top-dressing.
High-grade Tobacco.
Fine-ground Bone.

N. Roy & Son, South Attleborough, Mass.:—

Animal Fertilizer No. 1.
Animal Fertilizer No. 2.

Russia Cement Co., Gloucester, Mass.:—

Essex Dry Ground Fish.
Essex Complete Manure for Potatoes, Roots and Vegetables.
Essex Complete Manure for Corn, Grain and Grass.
Essex Market-garden and Potato Manure.
Essex A. L. Superphosphate.
Essex X.X.X. Fish and Potash.
Essex Odorless Lawn Dressing.
Essex Special Tobacco Manure.
Essex Tobacco Starter.
Essex Corn Fertilizer.

Sanderson Fertilizer and Chemical Co.,
New Haven, Conn. :—
Sanderson's Old Reliable.
Sanderson's Special Strawberry.
Sanderson's Formula A.
Sanderson's Formula B.

Thomas L. Stetson, Randolph, Mass. :—
Ground Bone.

James P. Trainor, Jamesville, Mass. :—
Ground Bone.

A. L. Warren, Northborough, Mass. :—
Fine-ground Bone.

Darius Whithed, Lowell, Mass. :—
Champion Animal Fertilizer.
Flour of Bone.

E. J. Whitman, Dracut, Mass. :—
Whitman's Potato Fertilizer, "Plow-
man's."
Whitman's Corn Fertilizer, "Suc-
cess."
Whitman's Pure Ground Bone.
Whitman's Pure Ground Meat.

Wilcox Fertilizer Works, Mystic,
Conn. :—
Potato, Onion and Tobacco Manure.
Complete Bone Superphosphate.
Potato Manure.
Fish and Potash.
Nitrate of Soda.
Muriate of Potash.

Sanford Winter, Brockton, Mass. :—
Pure Fine-ground Bone.

J. M. Woodard & Bro., Greenfield,
Mass. :—
Tankage.

PART II. — REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

CHARLES A. GOESSMANN.

1. Analysis of materials sent on for examination.
2. Notes on wood ashes.

1. ANALYSIS OF MATERIALS SENT ON FOR EXAMINATION.

During the season of 1901, 217 samples of fertilizing materials of various description have been received from farmers within our State. The results of our examination of these substances have been published in three bulletins: No. 74, March; No. 75, July; and No. 77, November, 1901, of the Hatch Experiment Station of the Massachusetts Agricultural College.

Next in importance to the analysis of licensed commercial fertilizers for inspection purposes is the examination of waste and by-products from different manufacturing industries. It has been the aim of the chemical division to encourage the use of different refuse and by-products for manurial purposes wherever the chemical analysis of such material proves them to be of sufficient value to merit their use.

The value of our work in this direction may be seen from year to year by the increased number of all kinds of waste products that are being forwarded to this department for investigation. The increased consumption of this class of materials for manurial purposes cannot but exert an important influence in favor of the agriculturalist on the consumption of commercial fertilizers. The examination of general fertilizing material is carried on free of charge to the farmers in the State, the material being taken up for analysis in the order of arrival of samples at this office.

Following is a list of materials received during the past season, which shows the great variety of substances which are used and valued for manurial purposes, as well as the great variety of work necessarily employed to keep in close touch with the critical examination of this class of materials:—

| | | | |
|-----------------------------------|----|------------------------------------|---|
| Wood ashes, | 72 | Sulfate of ammonia, | 1 |
| Complete fertilizers, | 27 | Acid phosphate, | 1 |
| Cotton-seed meal, | 17 | Tennessee phosphate, | 1 |
| Soils, | 15 | Superphosphate, | 1 |
| Muriate of potash, | 8 | Plain superphosphate, | 1 |
| Onions, | 8 | Marl, | 1 |
| Muck, | 7 | Sewage, | 1 |
| Nitrate of soda, | 6 | Lime-kiln ashes, | 1 |
| Tankage, | 4 | Carbonate of lime, | 1 |
| Cotton-hull ashes, | 4 | Waste from gas house, | 1 |
| Ground bone, | 3 | Pulverized sheep manure, | 1 |
| Dissolved bone-black, | 3 | Hair waste, | 1 |
| Blood, bone and meat, | 2 | Jadoo fibre, | 1 |
| Ground fish, | 2 | Tobacco stems, | 1 |
| Concentrated phosphate, | 2 | Tobacco dust, | 1 |
| Mud, | 2 | Walnut ashes, | 1 |
| Hen manure, | 2 | Pine-wood ashes, | 1 |
| Barnyard manure, | 2 | Ashes from soft coal and saw- | |
| Wool waste, | 2 | dust, | 1 |
| Raw bone meal, | 1 | Linseed meal, | 1 |
| Steamed bone meal, | 1 | Sal-ammoniac, | 1 |
| Condensed bone steam, | 1 | Salt, | 1 |
| Fresh-cut bone, | 1 | Asparagus tops, | 1 |
| Burned bone, | 1 | Milk casein, | 1 |
| Fleshings, | 1 | | |

Under the division of general work in the chemical laboratory may also be classed investigations along various lines which are constantly being carried on, such as: a study of the physical and chemical conditions of soil, and their relation to the solubility of different substances applied for fertilizing purposes; investigations of the availability of the different elements of plant food in the soil; new and improved methods for the ash analysis of plants; critical examination of methods of analysis of insecticides and fungicides found in our market; ammonia absorption tests, to determine the most efficient chemical to be used as a fixer

or absorber of ammonia in manure composting; investigation work for the Association of Official Agricultural Chemists, for the establishment of new and improved methods of analyses of agricultural products, etc. The results of the above-stated investigations will be published later, as in the past, whenever the results prove of general interest to the public.

2. NOTES ON WOOD ASHES.

During the season of 1901, 33.1 per cent. of the materials forwarded for analysis consisted of wood ashes, as against 30.8 per cent. the previous year.

The following table shows the general chemical character of wood ashes that have been forwarded for investigation during the season of 1901:—

Analysis of Wood Ashes.

| CONSTITUENTS. | NUMBER OF SAMPLES. | |
|--|--------------------|-------|
| | 1900. | 1901. |
| Moisture below 1 per cent., | 1 | 2 |
| Moisture from 1 to 10 per cent., | 25 | 28 |
| Moisture from 10 to 20 per cent., | 32 | 31 |
| Moisture from 20 to 30 per cent., | 13 | 7 |
| Moisture above 30 per cent., | 1 | — |
| Potassium oxide above 8 per cent., | 1 | 4 |
| Potassium oxide from 7 to 8 per cent., | 6 | 5 |
| Potassium oxide from 6 to 7 per cent., | 12 | 17 |
| Potassium oxide from 5 to 6 per cent., | 25 | 24 |
| Potassium oxide from 4 to 5 per cent., | 14 | 10 |
| Potassium oxide from 3 to 4 per cent., | 7 | 7 |
| Potassium oxide below 3 per cent., | 7 | 1 |
| Phosphoric acid above 2 per cent., | 6 | 5 |
| Phosphoric acid from 1 to 2 per cent., | 62 | 61 |
| Phosphoric acid below 1 per cent., | 4 | 2 |
| Average per cent. of calcium oxide (lime), | 32.51 | 33.20 |
| Per cent. of mineral matter insoluble in diluted hydrochloric acid:— | | |
| Below 10 per cent., | 15 | 22 |
| Between 10 and 15 per cent., | 35 | 24 |
| Between 15 and 20 per cent., | 12 | 17 |
| Above 20 per cent., | 11 | 4 |

From a comparison of the above-stated results of analyses of wood ashes with the results of the previous year, it will be seen that the average standard of composition is somewhat higher than in 1900.

To assist our farmers in selecting the best quality of wood ashes which the market affords, it is imperative that those sending samples for analysis should give us all the general information they possess in regard to the source from which the ashes were obtained, etc. With this idea in view, we caused to be published in our March bulletin, No. 74, a copy of a blank application for free analysis of fertilizing materials, which will hereafter be sent from this office to every applicant for an analysis free of charge. We believe the result of this course will be to impart a more general and intelligent interest in this department of work at the institution, and it will surely make known the names of the licensed as well as the unlicensed dealers in our State. We take this occasion to urge the farmers to patronize the dealers who are on record at our institution, as having complied with our State laws for the regulation of the trade in commercial fertilizers, which includes wood ashes, which are sold in our State for manurial purposes, rather than those who have failed to secure such a license.

In deciding the commercial value of wood ashes, it is well to consider the large quantity of calcium oxide (lime) that is present in a most superior form.

PART III. — COMPILATION OF ANALYSES OF AGRICULTURAL
CHEMICALS, REFUSE SALTS, ASHES, LIME COMPOUNDS,
REFUSE SUBSTANCES, GUANOS, PHOSPHATES AND ANIMAL
EXCREMENTS.

H. D. HASKINS.

1. Chemicals, refuse salts, etc.
2. Ashes, marls, lime compounds, etc.
3. Refuse substances.
4. Guanos, phosphates, etc.
5. Animal excrements, etc.
6. Average per cents. of the different ingredients found in the preceding compilation of analyses, calculated to pounds per ton of 2,000 pounds.

1868 to 1901.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1895, contained in the reports of the secretary of the Massachusetts State Board of Agriculture for these years, and in the bulletins of the department of chemistry of the Hatch Experiment Station of the Massachusetts Agricultural College since March, 1895.

No valuation is stated in this compilation, as the basis of valuation changes from year to year.

In the following compilation of agricultural chemicals, refuse materials, manurial substances, etc., the signification of the star (*) prefixed to the name of the substance is that the compilation is made up of analyses subsequent to the year 1897. It was believed that a compilation made up of more recent analyses would more nearly represent the present general chemical character of the substances, and would therefore be of more practical value.

It must be understood that the chemical character of many of the refuse substances used for manurial purposes is constantly undergoing changes, due to frequent variations in the parent industry.

As a rule, in all succeeding analyses the essential constituents are determined and stated; blanks do not imply the absence of the non-essentials.

| | | | | | | | | | | | | | | | | |
|----------------------------------|----|-------|---|------|-----|------|-------|------|-------|---|------|-------|-----|-------|---|-------|
| * Sulfate of magnesia, | 10 | 23.76 | - | - | - | - | - | - | - | - | 2.82 | 17.40 | - | 36.10 | - | 5.73 |
| * Sulfate of soda, | 1 | 1.38 | - | - | - | - | - | - | - | - | - | - | - | 59.43 | - | - |
| Saltpetre waste, | 12 | 2.54 | - | 3.30 | .52 | 2.22 | 30.94 | 1.55 | 13.66 | - | - | .75 | .19 | 1.85 | - | 46.25 |

2. *Ashes, Marls, Lime Compounds, etc.*

| | | | | | | | | | | | | | | | | | | | | | |
|--|----|-------|-------|---|---|------|-------|-------|-------|-------|------|-------|---|------|------|-------|-------|-------|-------|-------|-------|
| Ashes of spent tan bark, | 5 | 4.84 | - | - | - | - | 2.87 | .60 | 1.81 | 2.77 | .13 | 1.36 | - | - | - | 31.11 | 3.39 | 1.78 | - | - | 25.21 |
| Ashes from cremation of swill, | 15 | 4.86 | - | - | - | - | 8.83 | 1.25 | 3.97 | 32.36 | 7.47 | 14.16 | - | - | - | - | 33.58 | 1.87 | 4.65 | - | 21.57 |
| Ashes from blue works, | 1 | 12.14 | 63.78 | - | - | - | - | - | 9.02 | - | - | - | - | - | - | - | - | - | - | - | 12.30 |
| * Ashes from cremation of garbage, | 3 | 3.01 | - | - | - | - | 6.01 | 3.72 | 5.13 | 10.21 | 7.16 | 8.77 | - | - | - | 15.65 | 20.22 | 1.16 | 9.22 | 4.57 | 10.85 |
| * Ashes from hay and straw, | 1 | .40 | - | - | - | - | - | - | 1.55 | - | - | 1.02 | - | - | - | - | 5.22 | - | - | - | 66.35 |
| * Ashes from jute waste, | 1 | .19 | - | - | - | - | - | - | .51 | - | - | .54 | - | - | - | 3.84 | 6.04 | .39 | 7.60 | - | .57 |
| * Ashes from peach tree trimmings, | 1 | .54 | - | - | - | - | - | - | 4.92 | - | - | 2.44 | - | - | - | 7.53 | 18.74 | - | 10.50 | 2.20 | 13.54 |
| Ammoniated marl, | 1 | 3.31 | - | - | - | 1.61 | - | - | - | - | - | 10.39 | - | .41 | 9.98 | - | - | - | - | - | - |
| * Bleachery refuse, | 2 | 4.19 | - | - | - | - | 1.24 | .35 | .79 | - | - | - | - | - | - | 11.03 | 35.79 | - | - | - | 23.09 |
| Bituminous coal ashes, | 2 | 3.66 | - | - | - | - | - | - | .38 | - | - | .44 | - | - | - | - | 1.88 | - | - | - | 74.17 |
| * Brick yard ashes, | 1 | .40 | - | - | - | - | - | - | 3.59 | - | - | 1.61 | - | - | - | - | 23.44 | - | - | - | 53.32 |
| * Cotton-seed hull ashes, | 21 | 7.97 | - | - | - | - | 32.80 | 15.20 | 23.93 | 11.00 | 6.26 | 8.70 | - | 6.88 | 1.28 | - | 7.20 | 12.64 | - | - | 18.30 |
| Corn-cob ashes, | 1 | 1.20 | - | - | - | - | - | - | 7.08 | - | - | 2.37 | - | - | - | - | 11.70 | - | 1.28 | - | 52.09 |
| * Carbonate of lime, | 1 | .47 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 52.98 | - | - | - | - |
| Gypsc, | 1 | 1.64 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 50.87 | - | - | - | 2.87 |
| * Gas house lime, | 3 | 22.28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 43.66 | 8.30 | - | 20.73 | 6.05 |

| | | | | | | | | | | | | | | | | | | |
|-------------------------------|-----|-------|---|---|---|---|------|------|------|------|-----|------|-------|------|------|------|------|-------|
| Peat ashes, | 1 | 4.67 | - | - | - | - | .46 | - | .11 | - | - | - | 2.28 | 1.63 | 6.13 | - | - | 45.17 |
| Railroad tie ashes, | 1 | 4.70 | - | - | - | - | .92 | - | .56 | - | - | - | 2.51 | - | - | - | - | 80.20 |
| Sea-weed ashes, | 1 | 1.47 | - | - | - | - | .92 | - | .30 | - | - | - | 8.76 | 6.06 | 4.37 | 2.98 | 6.60 | 63.65 |
| * Wood ashes, | 340 | 11.17 | - | - | - | - | 8.86 | 1.12 | 5.63 | 2.82 | .06 | 1.32 | 34.54 | 3.31 | 7.43 | - | - | 18.28 |
| * Waste lime, | 1 | .80 | - | - | - | - | - | - | - | - | - | - | 74.12 | - | - | - | - | .38 |
| Virginia marls, | 2 | 15.98 | - | - | - | - | .61 | .37 | .49 | .09 | .08 | .09 | 7.25 | .21 | - | .66 | 7.25 | 64.23 |

3. Refuse Substances.

| | | | | | | | | | | | | | | | | | | |
|---|----|-------|------|------|------|-------|------|-------|-------|-------|-------|------|------|-------|------|---|---|-------|
| Ammoniate, | 1 | 5.88 | - | - | - | 11.33 | - | - | - | - | - | 3.43 | - | - | - | - | - | 1.38 |
| * Blood and bone, | 5 | 5.97 | 7.19 | 5.70 | 6.23 | 6.23 | - | - | 12.86 | 11.38 | 12.14 | - | 4.41 | 7.73 | - | - | - | - |
| Bone soup, | 1 | 82.92 | 7.07 | - | - | 1.14 | - | - | - | - | 1.26 | - | - | - | - | - | - | - |
| * Bone from fish, | 1 | 8.78 | - | - | - | 4.82 | - | - | - | - | 23.54 | - | 8.04 | 15.50 | - | - | - | - |
| * Broom-corn seed, | 1 | 7.40 | - | - | - | 1.51 | - | .50 | - | - | .57 | - | - | - | - | - | - | - |
| * Banana skins, | 1 | 13.99 | - | - | - | .24 | - | 5.46 | - | - | 1.80 | - | - | - | - | - | - | 5.53 |
| Blue-green algae (<i>Lyngbia Majasculas</i>), | 1 | 16.26 | - | - | - | 4.25 | - | .79 | - | - | .19 | - | - | - | 1.18 | - | - | - |
| * Concentrated wool washings, | 1 | 41.13 | - | - | - | 1.09 | - | 10.15 | - | - | .10 | - | - | - | - | - | - | - |
| * Condensed bone steam, | 1 | 81.75 | - | - | - | 1.94 | - | - | - | - | .07 | - | - | - | - | - | - | - |
| * Castor-bean pomace, | 3 | 7.87 | 5.70 | 5.85 | 4.98 | 5.47 | 3.40 | .64 | 1.20 | 2.26 | 1.57 | 2.12 | - | .87 | .29 | - | - | 1.75 |
| * Cotton-seed meal, | 67 | 6.88 | - | 7.99 | 3.24 | 7.04 | 1.92 | 1.41 | 1.64 | 3.30 | 1.71 | 2.56 | - | - | - | - | - | .28 |
| * Cork dust, | 1 | .74 | - | - | - | .59 | - | - | .33 | - | - | .10 | - | .74 | .08 | - | - | .24 |
| * Cotton waste, wet, | 3 | 26.35 | - | 1.21 | .84 | 1.08 | .61 | .43 | .53 | .74 | .69 | .75 | - | 2.12 | - | - | - | 41.90 |

3. Refuse Substances — Continued.

| FERTILIZER MATERIALS. | Analyses. | Moisture. | Ash. | NITROGEN. | | | POTASH. | | | TOTAL PHOS- PHORIC ACID. | | | Soluble Phos- phoric Acid. | Reverted Phos- phoric Acid. | Insoluble Phos- phoric Acid. | Sodium Oxide. | Calcium Oxide (Lime). | Magnesium Oxide. | Ferric and Alu- minic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Mat- ter. |
|---|-----------|-----------|-------|-----------|----------|----------|----------|----------|----------|-----------------------------|----------|----------|-------------------------------|--------------------------------|---------------------------------|---------------|--------------------------|---------------------|----------------------------------|-----------------|----------------|-----------|------------------------|
| | | | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | | | | | | | | | | | |
| * Cotton waste, dry, | 1 | 6.45 | - | 1.60 | .91 | 1.20 | 1.40 | .88 | 1.21 | .66 | .17 | .39 | - | - | - | - | 1.12 | - | - | - | - | - | 20.78 |
| Cotton dust, | 2 | 32.68 | 50.93 | - | - | .78 | - | - | .45 | - | - | .32 | - | - | - | - | - | - | - | - | - | - | 42.22 |
| * Dried blood, | 22 | 9.01 | 6.37 | 13.55 | 8.10 | 9.84 | - | - | - | 8.70 | 1.30 | 2.07 | - | - | - | - | - | - | - | - | - | - | - |
| Dried soup from meat and bone, . . | 1 | 14.80 | 8.40 | - | - | 9.97 | - | - | - | - | - | .53 | - | - | - | - | - | - | - | - | - | - | .64 |
| Dried soup from rendering cattle feet, | 1 | 10.80 | 7.50 | - | - | 14.47 | - | - | - | - | - | .46 | - | - | - | - | - | - | - | - | - | - | .26 |
| * Dry ground fish, | 21 | 9.07 | - | 10.48 | 7.44 | 8.56 | - | - | - | 16.07 | 5.70 | 8.98 | - | 4.21 | 4.73 | - | - | - | - | - | - | - | - |
| * Damaged grain, | 3 | 42.15 | - | 1.97 | .84 | 1.44 | .43 | .16 | .28 | .83 | .35 | .55 | - | - | - | - | - | - | - | - | - | - | - |
| * Deposit from Charles River, . . . | 1 | 21.46 | - | - | - | .95 | - | - | .59 | - | - | .74 | - | - | - | - | 1.81 | - | - | - | .54 | - | 44.27 |
| * Dredgings from Cape Cod, . . . | 1 | 18.99 | - | - | - | .99 | - | - | .13 | - | - | .07 | - | - | - | - | - | 2.06 | - | - | - | - | - |
| * Deposit from pond, | 1 | 4.01 | - | - | - | .41 | - | - | .26 | - | - | .32 | - | - | - | - | .62 | - | - | - | - | - | - |
| El grass, | 2 | 35.39 | 15.60 | .96 | .70 | .83 | 1.61 | .21 | .91 | .41 | .22 | .32 | - | - | - | 1.63 | 2.13 | .11 | - | - | - | - | 1.06 |
| Felt refuse, | 1 | 29.24 | 33.53 | - | - | 5.26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| * Fleshings, | 1 | 6.96 | 43.14 | - | - | 7.55 | - | - | - | - | - | .31 | - | - | - | - | - | - | - | - | - | - | - |
| * Fresh-cut bone, | 1 | 24.98 | - | - | - | 3.00 | - | - | - | - | - | 16.85 | - | 5.26 | 11.59 | - | - | - | - | - | - | - | - |
| Fish with 20 to 40 per cent. water, . | 10 | 30.19 | 20.59 | 7.41 | 4.22 | 5.97 | - | - | - | 8.32 | 4.68 | 7.09 | .74 | 2.69 | 3.64 | - | - | - | - | - | - | - | 1.68 |
| Fish with more than 40 per cent. water, | 10 | 45.46 | 15.50 | 7.60 | 2.43 | 4.97 | - | - | - | 8.56 | 2.94 | 5.08 | 1.17 | 1.33 | 2.58 | - | - | - | - | - | - | - | 1.35 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------------|-----|-------|-------|-------|-------|-------|------|------|------|-------|-------|-------|---|------|-------|------|-------|-------|------|------|---|-------|-------|
| Fresh-water mud, | 1 | 40.37 | - | - | - | - | 1.37 | - | .22 | - | - | .26 | - | - | - | - | - | 1.27 | .29 | 1.80 | - | - | 18.26 |
| * Ground tobacco stems, | 8 | 8.84 | 20.20 | 2.72 | .99 | 2.02 | 8.18 | 3.88 | 6.15 | 1.15 | .32 | .62 | - | - | - | - | - | 6.75 | - | - | - | - | 1.30 |
| * Ground bones, | 135 | 5.51 | 66.14 | 4.99 | 1.17 | 3.10 | - | - | - | 31.42 | 16.18 | 24.30 | - | 7.55 | 16.73 | - | - | - | - | - | - | - | 1.08 |
| Glucose refuse, | 1 | 8.10 | - | - | - | 2.62 | - | - | .15 | - | - | .29 | - | - | - | - | - | .18 | .02 | - | - | - | .07 |
| Horn shavings, | 1 | 4.83 | - | - | - | 15.31 | - | - | - | - | - | .42 | - | - | - | - | - | - | - | - | - | - | |
| * Hoof meal, | 1 | 4.10 | - | - | - | 15.19 | - | - | - | - | - | .77 | - | - | - | - | - | - | - | - | - | - | |
| Horn-and-hoof waste, | 3 | 10.17 | 7.63 | 15.49 | 11.84 | 13.25 | - | - | - | 2.30 | 1.36 | 1.83 | - | - | - | - | - | - | - | - | - | .24 | |
| * Hair waste, | 1 | 6.52 | 22.77 | - | - | 9.22 | - | - | .14 | - | - | .51 | - | - | - | - | 4.10 | - | - | - | - | - | |
| * Hop refuse, | 2 | 84.56 | 1.71 | .69 | .49 | .59 | .06 | .05 | .05 | .11 | .10 | .10 | - | - | - | - | - | - | - | - | - | .83 | |
| Ivory dust, | 1 | 11.50 | 52.63 | - | - | 6.64 | - | - | - | - | - | 24.56 | - | .97 | 17.97 | 5.62 | - | - | - | - | - | - | |
| * Jadoo fibre, | 1 | 11.53 | 11.60 | - | - | .97 | - | - | .48 | - | - | 1.24 | - | - | - | - | - | 3.50 | - | - | - | 4.05 | |
| Jute waste, | 1 | 13.10 | - | - | - | 1.50 | - | - | .08 | - | - | .72 | - | - | - | - | - | - | - | - | - | - | |
| * Kiln dust from brewery, | 1 | 9.72 | - | - | - | 4.32 | - | - | 2.16 | - | - | .96 | - | - | - | - | - | .78 | - | - | - | 7.11 | |
| * Linseed meal, | 3 | 8.23 | - | 6.42 | 5.26 | 5.69 | 1.58 | 1.46 | 1.52 | 1.59 | 1.36 | 1.47 | - | - | - | - | - | - | - | - | - | .58 | |
| Lobster shells, | 1 | 7.27 | - | - | - | 4.50 | - | - | - | - | - | 3.52 | - | - | - | - | - | 22.24 | 1.30 | - | - | .27 | |
| * Meat meal, | 1 | 3.22 | 8.55 | - | - | 9.23 | - | - | - | - | - | 3.08 | - | - | - | - | - | - | - | - | - | - | |
| Meat mass, | 5 | 12.09 | 13.60 | 11.50 | 9.69 | 10.44 | - | - | - | 3.58 | .56 | 2.07 | - | - | - | - | - | - | - | - | - | .58 | |
| Meat scrap, | 2 | 24.79 | - | - | - | 6.33 | - | - | - | - | - | 5.79 | - | - | - | - | - | - | - | - | - | - | |
| Morocco factory waste, | 1 | 22.72 | - | - | - | 1.16 | - | - | .36 | - | - | 2.56 | - | - | - | - | 19.60 | - | - | 1.24 | - | 24.17 | |
| * Meat and bone, | 6 | 5.66 | - | 7.15 | 4.66 | 5.30 | - | - | - | 18.83 | 14.71 | 17.15 | - | 5.61 | 11.54 | - | - | - | - | - | - | - | |
| Mill sweepings, | 1 | 9.49 | - | - | - | 3.76 | - | - | .66 | - | - | 1.18 | - | - | - | - | - | - | - | - | - | 5.01 | |
| Madder, | 2 | 11.93 | - | - | - | .91 | - | - | 2.40 | - | - | .35 | - | - | - | - | - | 3.93 | .51 | - | - | 4.67 | |

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|--|----|-------|-------|------|------|------|------|------|------|-------|-------|-------|---|------|-------|------|------|------|------|-----|-------|
| Sponge refuse, | 1 | 7.25 | - | - | - | 2.43 | - | - | - | 3.19 | - | - | - | - | 3.94 | 1.27 | - | - | - | - | 39.05 |
| * Sizing paste, | 1 | 61.45 | 5.58 | - | - | 1.13 | - | - | - | .02 | - | - | - | - | - | - | - | - | - | - | - |
| * Sizing waste, | 1 | 74.00 | - | - | - | .01 | - | - | 40 | .01 | - | - | - | - | - | - | - | - | - | - | 1.43 |
| Soap-grease refuse, | 2 | 29.25 | 51.39 | 4.20 | 2.21 | 3.21 | - | - | - | 15.37 | 11.04 | 13.21 | - | - | - | - | - | - | - | - | 1.29 |
| Soup from horse rendering, | 1 | 92.14 | - | - | - | 1.12 | - | - | - | .14 | - | - | - | - | - | - | - | - | - | - | - |
| * Spent brewers' grain, | 1 | 73.10 | - | - | - | 1.23 | - | - | .07 | .33 | - | - | - | - | - | - | - | - | - | - | - |
| * Spent bone-black, | 1 | 1.16 | - | - | - | - | - | - | - | 31.02 | - | - | - | 1.96 | 29.06 | - | - | - | - | - | - |
| Sumac waste, | 1 | 63.06 | 6.80 | - | - | 1.19 | - | - | 3.25 | - | - | - | - | - | - | 1.14 | 3.25 | - | - | - | 2.25 |
| Starch waste from rubber factory, | 1 | 10.01 | .23 | - | - | .02 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| * Sludge from sewage precipitating tanks, | 4 | 37.74 | - | 1.31 | .46 | .91 | .66 | .07 | .25 | .86 | .39 | .61 | - | - | 3.10 | 2.19 | 8.55 | .41 | 4.86 | - | 28.70 |
| * Sewage, | 2 | 78.07 | - | .77 | .30 | .40 | - | - | .27 | - | - | .85 | - | - | - | - | - | - | - | .03 | 20.06 |
| Salt mud, | 2 | 53.37 | 41.19 | .40 | .39 | .40 | .33 | .32 | .33 | - | - | - | - | - | .94 | .91 | .37 | 4.13 | - | - | 34.88 |
| * Soot, | 2 | 8.60 | - | - | - | .77 | 1.57 | .17 | .87 | .72 | .23 | .47 | - | - | 2.92 | 1.19 | 6.38 | - | - | - | 71.07 |
| * Tankage, | 40 | 7.03 | - | 9.02 | 4.11 | 5.95 | - | - | - | 21.62 | 5.65 | 14.46 | - | 6.21 | 8.02 | - | - | - | - | - | - |
| * Tobacco dust, | 4 | 6.08 | - | 2.25 | 1.75 | 2.06 | 6.81 | 2.07 | 4.33 | 1.28 | .36 | .72 | - | - | 3.09 | - | - | - | - | - | 16.59 |
| Tobacco leaves, | 1 | 13.05 | 21.01 | - | - | 2.75 | - | - | 7.24 | - | - | .43 | - | - | 4.17 | 2.17 | .32 | - | - | - | 4.17 |
| * Tobacco stalks exposed to the action of weather, | 1 | 7.58 | - | - | - | 1.18 | - | - | .52 | - | - | .38 | - | - | - | - | - | - | - | - | 1.86 |
| * Teopik fibre, | 1 | 56.54 | - | - | - | .53 | - | - | 1.26 | - | - | .55 | - | - | 5.15 | - | - | - | - | - | .75 |
| Turf, | 2 | 19.29 | 6.36 | 1.97 | 1.91 | 1.94 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| * Undried tankage, | 1 | 29.00 | - | - | - | 1.06 | - | - | - | - | - | 3.51 | - | 2.94 | .51 | - | - | - | - | - | - |
| * Wool waste, | 4 | 6.03 | 20.10 | 4.60 | .39 | 2.63 | 3.74 | .29 | 1.65 | 1.02 | .27 | .80 | - | - | 2.03 | .06 | .80 | - | - | - | 30.69 |
| Wool washings, water, | 1 | - | - | - | - | - | - | - | 3.92 | - | - | - | - | - | .49 | .28 | - | - | - | - | - |

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|--|----|-------|-------|-------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|-------|
| Bat guano from Florida, | 2 | 15.66 | - | - | - | - | 1.77 | 3.44 | 3.26 | 3.35 | - | - | - | - | - | - | - | - | 19.33 |
| * Bat guano from Havana, Cuba, | 1 | 6.95 | - | - | - | 6.96 | .53 | - | - | 5.04 | - | 6.17 | 10.89 | - | 5.76 | - | - | - | .40 |
| Cuban guano, | 5 | 24.27 | - | - | 2.74 | .63 | 1.67 | 16.16 | 11.54 | 13.35 | - | - | - | - | - | - | - | - | 3.17 |
| Caribbean guano (orchilla), | 12 | 7.31 | - | - | - | - | - | 35.43 | 18.11 | 26.77 | - | - | - | 39.95 | 3.29 | 2.68 | - | - | 1.27 |
| * Dissolved bone-black, | 18 | 11.97 | - | - | - | - | - | 20.93 | 15.60 | 17.66 | 14.04 | 2.94 | .76 | - | - | - | - | - | - |
| * Double superphosphate, | 2 | 6.27 | - | - | - | - | - | 50.14 | 45.42 | 47.78 | 18.36 | 20.97 | 8.45 | - | - | - | - | - | - |
| * Dissolved bone meal, | 7 | 5.73 | - | 4.64 | 1.66 | 2.56 | - | 22.26 | 15.04 | 17.93 | 3.95 | 8.72 | 5.26 | - | - | - | - | - | - |
| * Damaraland guano, | 1 | 17.70 | - | - | - | 5.79 | - | 3.53 | - | 14.78 | 4.90 | 5.79 | 4.09 | 7.03 | 14.21 | 2.05 | 5.94 | 5.77 | 9.26 |
| * Florida rock phosphate, | 2 | .53 | - | - | - | - | - | 40.34 | 33.10 | 36.72 | - | .10 | 36.62 | - | - | - | - | - | - |
| * Florida soft phosphate, | 1 | 4.46 | - | - | - | - | - | - | - | 26.48 | - | .38 | 26.10 | - | - | - | - | - | - |
| * Mona Island guano, | 1 | 13.32 | - | - | - | .76 | - | - | - | 21.88 | - | 7.55 | 14.33 | - | 37.49 | - | - | - | 2.45 |
| * Novassu phosphate, | 1 | 5.77 | - | - | - | - | - | - | - | 24.56 | - | 1.66 | 22.90 | - | - | - | - | - | - |
| Odorless phosphate, | 6 | 2.99 | - | - | - | - | .52 | .04 | .38 | 21.74 | 18.40 | .52 | 19.82 | - | 51.42 | - | 2.51 | - | 9.14 |
| * Phosphate slag, | 2 | .95 | - | - | - | - | - | - | - | 19.80 | 15.70 | 6.04 | 13.76 | - | 39.24 | - | - | - | 9.91 |
| Peruvian guano, | 26 | 14.81 | 37.61 | 13.50 | 4.44 | 7.85 | 4.08 | 1.14 | 2.61 | 20.60 | 5.96 | 4.57 | 3.79 | 6.90 | - | - | - | - | 6.60 |
| Rat guano from Florida, | 1 | 10.32 | - | - | - | 3.32 | - | - | 6.85 | - | 2.30 | - | - | - | - | - | - | - | 1.15 |
| * South Carolina rock phosphate, | 3 | .88 | - | - | - | - | - | - | - | 31.87 | 25.58 | 27.98 | 2.63 | 23.41 | - | - | - | - | - |
| South Carolina floats, | 1 | .83 | - | - | - | - | - | - | - | - | 23.39 | 2.33 | 21.06 | - | - | - | - | - | 20.16 |
| South American bone ash, | 1 | 7.00 | - | - | - | - | - | - | - | - | 35.89 | - | - | - | 44.89 | - | - | - | 4.50 |
| * Tennessee phosphate, | 1 | .37 | - | - | - | - | - | - | .44 | - | 33.00 | - | - | - | - | - | - | - | - |
| Upton phosphate, | 1 | 9.07 | - | - | - | - | - | - | - | - | 40.15 | 37.84 | 2.31 | - | - | - | - | - | - |

6. *Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds.*

| FERTILIZER MATERIALS. | Moisture. | Ash. | Nitrogen. | Potash. | Total Phosphoric Acid. | Sodium Oxide. | Calcium Oxide (lime). | Magnesium Oxide. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|--|-----------|------|-----------|---------|------------------------|---------------|-----------------------|------------------|-----------------------------|-----------------|----------------|-----------|-------------------|
| <i>1. Chemicals, Refuse Salts, etc.</i> | | | | | | | | | | | | | |
| Carbonate of potash, | 538 | - | - | 370 | - | - | - | 390 | - | - | - | - | 8 |
| Carnalite, | - | - | - | 274 | - | 153 | - | 264 | - | 11 | - | 831 | - |
| * Kainit, | 37 | - | - | 255 | - | 379 | 47 | 127 | - | 405 | - | 413 | 43 |
| Krugite, | 96 | - | - | 168 | - | 105 | 249 | 176 | - | 639 | - | 133 | 299 |
| * Muriate of potash, | 28 | - | - | 998 | - | 134 | - | 11 | - | - | - | 976 | 14 |
| Nitrate of potash, | 26 | - | 254 | 905 | - | - | - | - | - | - | - | - | - |
| * Nitrate of soda, | 27 | - | 310 | - | - | 710 | - | - | - | - | - | 10 | 10 |
| Nitre salt cake, | 121 | - | 46 | 17 | - | 591 | - | - | - | 955 | - | - | 78 |
| Phosphate of potash, | 75 | - | - | 651 | 750 | - | - | - | - | 269 | - | - | 18 |
| Phosphate of ammonia, | 121 | - | 207 | - | 877 | - | - | - | - | 249 | - | - | 16 |
| * Potash refuse from manufacture of cyanide of potash, | 785 | - | 19 | 147 | - | - | - | - | - | - | - | - | - |
| * Sulfate of ammonia, | 22 | - | 413 | - | - | - | - | - | - | 1,200 | - | - | - |
| * Sulfate of potash, | 18 | - | - | 990 | - | 89 | - | 30 | - | 914 | - | - | 15 |

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

| FERTILIZER MATERIALS. | Moisture. | Ash. | Nitrogen. | Potash. | Total Phosphoric Acid. | Sodium Oxide. | Calcium Oxide (lime). | Magnesium Oxide. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|--|-----------|-------|-----------|---------|------------------------|---------------|-----------------------|------------------|-----------------------------|-----------------|----------------|-----------|-------------------|
| 1. Chemicals, Refuse Salts, etc. — Con. | | | | | | | | | | | | | |
| * Sulfate of potash-magnesium, | 97 | - | - | 498 | - | 125 | 51 | - | - | 885 | - | 52 | 28 |
| * Silicate of potash, | 41 | - | - | 491 | - | - | - | - | - | - | - | - | - |
| * Sulfate of magnesia, | 475 | - | - | - | - | - | 56 | 348 | - | 722 | - | - | 115 |
| * Sulfate of soda, | 28 | - | - | - | - | - | - | - | - | 1,189 | - | - | - |
| Saltpetre waste, | 51 | - | 44 | 273 | - | 741 | 15 | 4 | - | 37 | - | 925 | - |
| 2. Ashes, Marls, Lime Compounds, etc. | | | | | | | | | | | | | |
| Ashes of spent tan bark, | 97 | - | - | 36 | 27 | - | 622 | 68 | 36 | - | - | - | 504 |
| Ashes from cremation of swill, | 97 | - | - | 79 | 283 | - | 672 | 37 | 93 | - | - | - | 431 |
| Ashes from blue works, | 243 | 1,276 | - | 180 | - | - | - | - | - | - | - | - | 246 |
| * Ashes from cremation of garbage, | 60 | - | - | 103 | 175 | 313 | 404 | 23 | 184 | 91 | 217 | 95 | 568 |
| * Ashes from hay and straw, | 8 | - | - | 31 | 20 | - | 104 | - | - | - | - | - | 1,327 |
| * Ashes from jute waste, | 4 | - | - | 10 | 11 | 77 | 121 | 8 | 152 | - | - | 11 | 1,620 |
| * Ashes from peach tree trimmings, | 11 | - | - | 98 | 49 | 151 | 375 | - | 210 | 44 | - | - | 271 |
| Ammoniated marl, | 66 | - | 32 | - | 208 | - | - | - | - | - | - | - | - |

| | | | | | | | | | | |
|--|-----|---|-----|-----|-----|-------|-----|-----|-----|-------|
| * Bleachery refuse, | 84 | - | 16 | - | 234 | 716 | - | - | - | 462 |
| Bituminous coal ashes, | 73 | - | 8 | 9 | - | 38 | - | - | - | 1,483 |
| * Brick yard ashes, | 8 | - | 72 | 32 | - | 469 | - | - | - | 1,066 |
| * Cotton-seed hull ashes, | 159 | - | 479 | 174 | - | 144 | 253 | - | - | 366 |
| Corn-cob ashes, | 24 | - | 142 | 47 | - | 234 | - | 26 | - | 1,042 |
| * Carbonate of lime, | 9 | - | - | - | - | 1,060 | - | - | - | - |
| Gypse, | 33 | - | - | - | - | 1,017 | - | - | - | 57 |
| * Gas house lime, | 446 | - | - | - | - | 873 | 166 | - | 415 | 121 |
| Green sand marl (Virginia), | 25 | - | 23 | 187 | - | 516 | - | 103 | - | 826 |
| Hard-pine wood ashes, | 15 | - | 203 | 45 | - | 499 | - | - | - | 598 |
| * Lime refuse from soda factory, | 481 | - | - | - | - | 297 | - | 27 | 463 | 33 |
| Lime waste from sugar factory, | 726 | - | 4 | 45 | - | 550 | - | - | - | 6 |
| Lime, | - | - | - | - | - | 1,873 | - | - | - | 27 |
| * Lime-kiln ashes, | 217 | - | 42 | 15 | - | 777 | 26 | - | - | 114 |
| * Leather scrap ashes, | 14 | - | 67 | 79 | - | 51 | - | - | - | 800 |
| Logwood ashes, | 30 | - | 2 | 46 | - | 78 | - | - | - | 194 |
| Mill ashes, | 11 | - | 32 | 9 | - | 699 | 27 | - | - | 727 |
| Magnolia ashes (Florida), | 32 | - | 51 | 9 | - | - | - | - | - | 122 |
| Massachusetts marls, | 274 | - | 5 | 21 | - | 810 | 13 | 14 | 571 | 69 |
| Marl (North Carolina), | 14 | - | 1 | 11 | - | 439 | 12 | - | - | 1,004 |
| * Nova Scotia plaster (gypsum), | 129 | - | - | - | - | 675 | 15 | - | 897 | 116 |
| Olive earth (Virginia), | 39 | - | 5 | 275 | - | 383 | - | 120 | - | 1,011 |

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds—Continued.

| FERTILIZER MATERIALS. | Moisture. | Ash. | Nitrogen. | Potash. | Total Phosphoric Acid. | Sodium Oxide. | Calcium Oxide (Lime). | Magnesium Oxide. | Ferrie and Alu- minic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|-----------|------|-----------|---------|------------------------|---------------|-----------------------|------------------|----------------------------------|-----------------|----------------|-----------|-------------------|
| 2. Ashes, Marls, Lime Compounds, etc.—Con. | | | | | | | | | | | | | |
| Onondaga plaster (New York gypsum), | 265 | - | - | - | - | - | 600 | 93 | - | 650 | 164 | - | 197 |
| * Picker waste ashes, | 6 | - | - | 131 | 24 | - | - | - | - | - | - | - | 1,269 |
| Peat ashes, | 93 | - | - | 9 | 2 | - | 46 | 33 | 123 | - | - | - | 903 |
| Railroad tie ashes, | 94 | - | - | 18 | 11 | - | 50 | - | - | - | - | - | 1,604 |
| Sea-weed ashes, | 29 | - | - | 18 | 6 | 175 | 121 | 87 | - | 60 | - | 132 | 1,273 |
| * Wood ashes, | 223 | - | - | 113 | 26 | - | 691 | 66 | 149 | - | - | - | 366 |
| * Waste lime, | 16 | - | - | - | - | - | 1,482 | - | - | - | - | - | 8 |
| Virginia marls, | 320 | - | - | 10 | 2 | - | 145 | 4 | - | 13 | 145 | - | 1,285 |
| 3. Refuse Substances. | | | | | | | | | | | | | |
| Ammoniate, | 118 | - | 227 | - | 69 | - | - | - | - | - | - | - | 28 |
| * Blood and bone, | 119 | - | 125 | - | 243 | - | - | - | - | - | - | - | - |
| Bone soup, | 1,658 | 141 | 23 | - | 25 | - | - | - | - | - | - | - | - |
| * Bone from fish, | 176 | - | 96 | - | 471 | - | - | - | - | - | - | - | - |
| * Broom-corn seed, | 148 | - | 30 | 10 | 11 | - | - | - | - | - | - | - | - |

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

| FERTILIZER MATERIALS. | Moisture. | Ash. | Nitrogen. | Potash. | Total Phosphoric Acid. | Sodium Oxide. | Calcium Oxide (lime). | Magnesium Oxide. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|-----------|-------|-----------|---------|------------------------|---------------|-----------------------|------------------|-----------------------------|-----------------|----------------|-----------|-------------------|
| 3. Refuse Substances — Con. | | | | | | | | | | | | | |
| Fish with 20 to 40 per cent. water, | 604 | 412 | 119 | - | 142 | - | - | - | - | - | - | - | 34 |
| Fish with more than 40 per cent. water, | 909 | 310 | 99 | - | 112 | - | - | - | - | - | - | - | 27 |
| Fresh-water mud, | 807 | - | 27 | 4 | 5 | - | 25 | 6 | 36 | - | - | - | 365 |
| * Ground tobacco stems, | 177 | 404 | 40 | 123 | 12 | - | 135 | - | - | - | - | - | 26 |
| * Ground bones, | 110 | 1,323 | 62 | - | 486 | - | - | - | - | - | - | - | 22 |
| Glucose refuse, | 162 | - | 52 | 3 | 6 | - | 4 | 4 | - | - | - | - | 1 |
| Horn shavings, | 97 | - | 306 | - | 8 | - | - | - | - | - | - | - | - |
| * Hoof meal, | 82 | - | 304 | - | 15 | - | - | - | - | - | - | - | - |
| Horn-and-hoof waste, | 203 | 153 | 265 | - | 37 | - | - | - | - | - | - | - | 5 |
| * Hair waste, | 130 | 455 | 184 | 3 | 10 | 82 | - | - | - | - | - | - | - |
| * Hop refuse, | 1,691 | 34 | 12 | 1 | 2 | - | - | - | - | - | - | - | 17 |
| Ivory dust, | 230 | 1,053 | 133 | - | 491 | - | - | - | - | - | - | - | - |
| * Jadoo fibre, | 231 | 232 | 19 | 10 | 25 | - | 70 | - | - | - | - | - | 81 |
| Jute waste, | 262 | - | 30 | 2 | 14 | - | - | - | - | - | - | - | - |

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

| FERTILIZER MATERIALS. | Moisture. | Ash. | Nitrogen. | Potash. | Total Phosphoric Acid. | Sodium Oxide. | Calcium Oxide (lime). | Magnesium Oxide. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|-----------|-------|-----------|---------|------------------------|---------------|-----------------------|------------------|-----------------------------|-----------------|----------------|-----------|-------------------|
| | | | | | | | | | | | | | |
| 3. Refuse Substances — Con. | | | | | | | | | | | | | |
| * Refuse from glass factory, | 330 | - | - | 390 | - | 122 | - | - | - | - | - | - | - |
| Rockweed, green, | 1,370 | 474 | 12 | - | - | - | - | - | - | - | - | - | - |
| Rockweed, dry, | 214 | 715 | 29 | 98 | 55 | 148 | 153 | 4 | - | - | - | - | 208 |
| Residue from water filter, | 1,884 | - | 2 | - | 1 | - | - | - | - | - | - | - | - |
| Sponge refuse, | 145 | - | 49 | - | 64 | - | 79 | 25 | - | - | - | - | 781 |
| * Sizing paste, | 1,229 | 112 | 23 | - | .4 | - | - | - | - | - | - | - | - |
| * Sizing waste, | 1,480 | - | .2 | 8 | .2 | - | - | - | - | - | - | - | 29 |
| Soap-grease refuse, | 585 | 1,028 | 22 | - | 3 | - | - | - | - | - | - | - | 26 |
| Soup from horse rendering, | 1,462 | - | 25 | 1 | 7 | - | - | - | - | - | - | - | - |
| * Spent brewers' grain, | 1,462 | - | 25 | 1 | 7 | - | - | - | - | - | - | - | - |
| * Spent bone-black, | 23 | - | - | - | 620 | - | - | - | - | - | - | - | - |
| Sumac waste, | 1,261 | 136 | 24 | 65 | - | - | 23 | 65 | - | - | - | - | 45 |
| Starch waste from rubber factory, | 200 | 5 | .4 | - | - | - | - | - | - | - | - | - | - |
| * Sludge from sewage precipitating tanks, | 755 | - | 18 | 5 | 12 | - | 62 | 44 | 171 | 8 | 97 | - | 574 |

| | | | | | | | | | | | |
|--|-------|-----|-----|-----|-----|----|-----|----|-----|---|-------|
| * Sewage, | 1,561 | - | 8 | 5 | 17 | - | - | - | - | 1 | 401 |
| Salt mud, | 1,067 | 824 | 8 | 7 | - | 19 | 18 | 7 | 83 | - | 698 |
| * Soot, | 172 | - | 15 | 17 | 9 | - | 58 | 24 | 128 | - | 1,421 |
| * Tankage, | 141 | - | 119 | - | 289 | - | - | - | - | - | - |
| * Tobacco dust, | 122 | - | 41 | 87 | 14 | - | 62 | - | - | - | 332 |
| Tobacco leaves, | 261 | 420 | 55 | 145 | 9 | - | 83 | 43 | 6 | - | 83 |
| * Tobacco stalks exposed to action of weather, | 152 | - | 24 | 10 | 8 | - | - | - | - | - | 37 |
| * Teopik fibre, | 1,131 | - | 11 | 25 | 11 | - | 103 | - | - | - | 15 |
| Turf, | 386 | 127 | 39 | - | - | - | - | - | - | - | - |
| * Undried tankage, | 580 | - | 21 | - | 70 | - | - | - | - | - | - |
| * Wool waste, | 121 | 402 | 53 | 33 | 16 | - | 41 | 1 | 16 | - | 614 |
| Wool washings, water, | - | - | - | 78 | - | 10 | 6 | - | - | - | - |
| Wool washings, acid, | - | - | - | 84 | - | 8 | 12 | 4 | - | - | - |
| Wool washings, alkaline, | 1,841 | 66 | 2 | 22 | - | 18 | 1 | - | - | - | 4 |
| Whale meat, raw, | 890 | 21 | 97 | - | - | - | - | - | - | - | - |
| Waste from lactate factory, | 612 | - | 14 | - | 13 | - | 452 | - | - | - | 138 |
| * Whale bone scrapings, | 14 | - | 260 | - | 5 | - | - | - | - | - | - |
| * Water abstract of dry forest leaves, | 1,989 | 3 | .08 | .6 | .44 | - | .5 | - | - | - | - |
| 4. Guanos, Phosphates, etc. | | | | | | | | | | | |
| * Acid phosphate, | 237 | - | - | - | 310 | - | - | - | - | - | - |
| * Apatite, | 1 | - | - | - | 704 | - | - | - | - | - | - |
| * Bone ash, | 7 | - | - | - | 783 | - | - | - | - | - | - |

6. Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Concluded.

| FERTILIZER MATERIALS. | Moisture. | Ash. | Nitrogen. | Potash. | Total Phosphoric Acid. | Sodium Oxide. | Calcium Oxide (lime). | Magnesium Oxide. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|--|-----------|------|-----------|---------|------------------------|---------------|-----------------------|------------------|-----------------------------|-----------------|----------------|-----------|-------------------|
| 4. Guanos, Phosphates, etc. — Con. | | | | | | | | | | | | | |
| Bone-black, | 92 | - | - | - | 566 | - | - | - | - | - | - | - | 73 |
| Brockville phosphate, | 50 | - | - | - | 704 | - | - | - | - | - | - | - | 129 |
| Bat guano from Texas, | 802 | 365 | 129 | 26 | 75 | - | - | - | - | - | - | - | 40 |
| Bat guano from Florida, | 313 | - | 195 | 35 | 67 | - | - | - | - | - | - | - | 387 |
| * Bat guano from Havana, Cuba, | 139 | - | 139 | 11 | 101 | 123 | 218 | - | 115 | - | - | - | 8 |
| Cuban guano, | 485 | - | 33 | - | 267 | - | - | - | - | - | - | - | 63 |
| Caribbean guano (orchilla), | 146 | - | - | - | 535 | - | 799 | 66 | - | 54 | - | - | 25 |
| * Dissolved bone-black, | 239 | - | - | - | 353 | - | - | - | - | - | - | - | - |
| * Double superphosphate, | 125 | - | - | - | 956 | - | - | - | - | - | - | - | - |
| * Dissolved bone meal, | 115 | - | 51 | - | 359 | - | - | - | - | - | - | - | - |
| * Damaraland guano, | 354 | - | 116 | 71 | 206 | 141 | 284 | 41 | - | 119 | - | 115 | 185 |
| * Florida rock phosphate, | 11 | - | - | - | 734 | - | - | - | - | - | - | - | - |
| * Florida soft phosphate, | 89 | - | - | - | 530 | - | - | - | - | - | - | - | - |
| * Mona Island guano, | 266 | - | 15 | - | 438 | - | 750 | - | - | - | - | - | 49 |

PART IV. — COMPILATION OF ANALYSES OF FRUITS, GARDEN CROPS AND INSECTICIDES.

H. D. HASKINS.

1. Analyses of fruits.
2. Analyses of garden crops.
3. Relative proportions of phosphoric acid, potassium oxide and nitrogen in fruits and garden crops.
4. Analyses of insecticides.

A computation of the results of a chemical analysis of twenty prominent garden crops shows the following average relative proportion of the three essential ingredients of plant food : —

| | Parts. |
|----------------------------|--------|
| Nitrogen, | 2.2 |
| Potassium oxide, | 2.0 |
| Phosphoric acid, | 1.0 |

One thousand pounds of green garden vegetables contain, on the above stated basis of relative proportion of essential constituents of plant food : —

| | Pounds. |
|----------------------------|---------|
| Nitrogen, | 4.1 |
| Potassium oxide, | 3.9 |
| Phosphoric acid, | 1.9 |

The weight and particular stage of growth of the vegetables when harvested control, under otherwise corresponding conditions, the actual consumption of each of these articles of plant food. Our information regarding these points is still too fragmentary to enable a more detailed statement here beyond relative proportions. It must suffice for the present to call attention to the fact that a liberal manuring within reasonable limit pays, as a rule, better than a scanty one. (C. A. GOESSMANN.)

1. ANALYSES OF FRUITS.

Fertilizing Constituents of Fruits (Parts per Thousand).

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|---------------------------|-----------|-----------|------|---------------------|---------------|-------------------|---------------------|---------------------|--------------------|-----------|
| Ericaceæ : — | | | | | | | | | | |
| * Cranberries, | 996 | — | 1.8 | .9 | .1 | .3 | .1 | .3 | — | — |
| * Cranberries, | 894 | .8 | — | 1.0 | — | .2 | .1 | .3 | — | — |
| Rosaceæ : — | | | | | | | | | | |
| Apples, | 831 | .6 | 2.2 | .8 | .6 | .1 | .2 | .3 | .1 | — |
| * Apples, | 799 | 1.3 | 4.1 | 1.9 | .3 | .3 | .3 | .1 | — | — |
| * Peaches, | 884 | — | 3.4 | 2.5 | — | .1 | .2 | .5 | — | — |
| Pears, | 831 | .6 | 3.3 | 1.8 | .3 | .3 | .2 | .5 | .2 | — |
| Strawberries, | 902 | — | 3.3 | .7 | .9 | .5 | — | .5 | .1 | .1 |
| * Strawberries, | — | — | 5.2 | 2.6 | .2 | .7 | .4 | 1.0 | — | — |

Fertilizing Constituents of Fruits — Concluded.

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|------------------------------|-----------|-----------|------|---------------------|---------------|-------------------|---------------------|---------------------|--------------------|-----------|
| <i>Rosaceæ — Con.</i> | | | | | | | | | | |
| * Strawberry vines, | — | — | 33.4 | 3.5 | 4.5 | 12.2 | 1.3 | 4.8 | — | — |
| Cherries, | 825 | — | 3.9 | 2.0 | .1 | .3 | .2 | .6 | .2 | .1 |
| Plums, | 838 | — | 2.9 | 1.7 | — | .3 | .2 | .4 | .1 | — |
| <i>Saxifragaceæ : —</i> | | | | | | | | | | |
| * Currants, white, | — | — | 5.9 | 3.1 | .2 | 1.0 | .3 | 1.1 | — | — |
| * Currants, red, | 871 | — | 4.1 | 1.9 | .2 | .8 | .3 | .9 | — | — |
| Gooseberries, | 903 | — | 3.3 | 1.3 | .3 | .4 | .2 | .7 | — | — |
| <i>Viticeæ : —</i> | | | | | | | | | | |
| Grapes, | 830 | 1.7 | 8.8 | 5.0 | .1 | 1.0 | .4 | 1.4 | .5 | .1 |
| Grape seed, | 110 | 19.0 | 22.7 | 6.9 | .5 | 5.6 | 1.4 | 7.0 | .8 | .1 |

2. ANALYSES OF GARDEN CROPS.

Fertilizing Constituents of Garden Crops (Parts per Thousand).

| | Molture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|------------------------------|----------|-----------|------|---------------------|---------------|-------------------|---------------------|---------------------|--------------------|-----------|
| Chenopodiaceæ:— | | | | | | | | | | |
| Mangolds, | 880 | 1.8 | 9.1 | 4.8 | 1.5 | .3 | .4 | .8 | .3 | .9 |
| * Mangolds, | 873 | 1.9 | 12.2 | 3.8 | 1.3 | .6 | .4 | .9 | — | — |
| Mangold leaves, | 905 | 3.0 | 14.6 | 4.5 | 2.8 | 1.6 | 1.4 | 1.0 | .8 | 2.3 |
| Sugar beets, | 805 | 1.6 | 7.1 | 3.8 | .6 | .4 | .6 | .9 | .3 | .3 |
| * Sugar beets, | 869 | 2.2 | 10.4 | 4.8 | .8 | .6 | .4 | 1.0 | .1 | — |
| Sugar beet tops, | 840 | 2.0 | 9.6 | 2.8 | 2.3 | .9 | 1.1 | 1.2 | .2 | .3 |
| Sugar beet leaves, | 897 | 3.0 | 15.3 | 4.0 | 2.0 | 3.1 | 1.7 | .7 | .8 | 1.3 |
| Sugar beet seed, | 146 | — | 45.3 | 11.1 | 4.2 | 10.2 | 7.3 | 7.5 | 2.0 | 1.9 |

Fertilizing Constituents of Garden Crops — Continued.

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|-----------------------------------|-----------|-----------|------|------------------|---------------|----------------|------------------|------------------|-----------------|-----------|
| <i>Chenopodiaceæ — Con.</i> | | | | | | | | | | |
| * Red beets, | 877 | 2.4 | 11.3 | 4.4 | .9 | .5 | .3 | .9 | — | . |
| Spinach, | 903 | 2.4 | 16.0 | 2.7 | 5.7 | 1.9 | 1.0 | 1.6 | 1.1 | 1.0 |
| * Spinach, | 922 | 3.4 | 9.6 | 9.6 | 2.1 | .6 | .5 | .5 | — | — |
| <i>Compositæ : —</i> | | | | | | | | | | |
| Lettuce, common, | 940 | — | 8.1 | 3.7 | .8 | .5 | .2 | .7 | .3 | .4 |
| Head lettuce, | 943 | 2.2 | 10.3 | 3.9 | .8 | 1.5 | .6 | 1.0 | .4 | .8 |
| * Head lettuce, | 970 | 1.2 | — | 2.3 | .2 | .3 | .1 | .3 | — | — |
| Roman lettuce, | 925 | 2.0 | 9.8 | 2.5 | 3.5 | 1.2 | .4 | 1.1 | .4 | .4 |
| Artichoke, | 811 | — | 10.1 | 2.4 | .7 | 1.0 | .4 | 3.9 | .5 | .2 |
| * Artichoke, Jerusalem, | 775 | 4.6 | — | 4.8 | — | — | — | 1.7 | — | — |

| | | | | | | | | | | |
|----------------------|---|---|---|-----|-----|------|-----|-----|-----|----------------|
| Convolvulaceæ: — | | | | | | | | | | |
| Sweet potato, | . | . | . | 758 | 2.4 | 7.4 | 3.7 | .5 | .7 | .3 .4 .9 |
| Crucifère: — | | | | | | | | | | |
| White turnips, | . | . | . | 920 | 1.8 | 6.4 | 2.9 | .6 | .7 | .2 .8 .7 .3 |
| * White turnips, | . | . | . | 895 | 1.8 | 10.1 | 3.9 | .8 | .9 | .3 1.0 1.0 — |
| White turnip leaves, | . | . | . | 898 | 3.0 | 11.9 | 2.8 | 1.1 | 3.9 | .5 .9 1.1 1.2 |
| * Ruta-bagas, | . | . | . | 891 | 1.9 | 10.6 | 4.9 | .7 | .9 | .3 1.2 — — |
| Savoy cabbage, | . | . | . | 871 | 5.3 | 14.0 | 3.9 | 1.4 | 3.0 | .5 2.1 1.2 1.1 |
| White cabbage, | . | . | . | 900 | 3.0 | 9.6 | 4.3 | .8 | 1.2 | .4 1.1 1.3 .5 |
| * White cabbage, | . | . | . | 984 | 2.3 | — | 3.4 | .3 | .2 | .1 .2 — — |
| Cabbage leaves, | . | . | . | 890 | 2.4 | 15.6 | 5.8 | 1.5 | 2.8 | .6 1.4 2.4 1.3 |
| Cauliflower, | . | . | . | 904 | 4.0 | 8.0 | 3.6 | .5 | .5 | .3 1.6 1.0 .3 |
| Horse-radish, | . | . | . | 767 | 4.3 | 19.7 | 7.7 | .4 | 2.0 | .4 2.0 4.9 .3 |
| Radishes, | . | . | . | 933 | 1.9 | 4.9 | 1.6 | 1.0 | .7 | .2 4.5 .3 .5 |
| Kohlrabi, | . | . | . | 850 | 4.8 | 12.3 | 4.3 | .8 | .4 | .8 2.7 1.1 .6 |

Fertilizing Constituents of Garden Crops — Continued.

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|---------------------------------------|-----------|-----------|------|---------------------|---------------|-------------------|---------------------|---------------------|--------------------|-----------|
| Cucurbitaceæ : — | | | | | | | | | | |
| Cucumbers, | 956 | 1.6 | 5.8 | 2.4 | .6 | .4 | .2 | 1.2 | .4 | .4 |
| Pumpkins, | 900 | 1.1 | 4.4 | .9 | .9 | .3 | .2 | .7 | .3 | .4 |
| Gramineæ : — | | | | | | | | | | |
| Corn, whole plant, green, | 829 | 1.9 | 10.4 | 3.7 | .5 | 1.4 | 1.1 | 1.0 | .3 | .5 |
| * Corn, whole plant, green, | 786 | 4.1 | — | 3.8 | .5 | 1.5 | .9 | 1.5 | — | — |
| Corn, kernels, | 144 | 16.0 | 12.4 | 3.7 | .1 | .3 | 1.9 | 5.7 | .1 | .2 |
| * Corn, kernels, | 100 | 18.2 | — | 4.0 | .3 | .3 | 2.1 | 7.0 | — | — |
| * Corn, whole ears, | 90 | 14.1 | — | 4.7 | .6 | .2 | 1.8 | 5.7 | — | — |
| * Corn stover, | 282 | 11.2 | 37.4 | 13.2 | 7.9 | 5.2 | 2.6 | 3.0 | — | — |

Leguminosæ : —

| | | | | | | | | | | |
|--|-------|------|------|------|-----|------|-----|------|-----|-----|
| Hay of peas, cut green, | 167 | 22.9 | 62.4 | 23.2 | 2.3 | 15.6 | 6.3 | 6.8 | 5.1 | 2.0 |
| * Cow-pea (<i>Dolichos</i>), green, | 788 | 2.9 | — | 3.1 | .6 | 3.0 | 1.0 | 1.0 | — | — |
| * Small pea (<i>Lathyrus Sylvestris</i>), dry, | 90 | 38.5 | — | 25.7 | 4.7 | 17.9 | 5.0 | 9.0 | — | — |
| Peas, seed, | 143 | 35.8 | 23.4 | 10.1 | .2 | 1.1 | 1.9 | 8.4 | .8 | .4 |
| Pea straw, | 160 | 10.4 | 43.1 | 9.9 | 1.8 | 15.9 | 3.5 | 3.5 | 2.7 | 2.3 |
| Garden beans, seed, | 150 | 39.0 | 27.4 | 12.1 | .4 | 1.5 | 2.1 | 9.7 | 1.1 | .3 |
| Bean straw, | 166 | — | 40.2 | 12.8 | 3.2 | 11.1 | 2.5 | 3.9 | 1.7 | 3.1 |
| * Velvet beans, kernel, | 111.6 | 31.1 | — | 13.2 | — | — | — | 7.7 | — | — |
| * Velvet beans, with pod, | 115.2 | 19.6 | — | 13.1 | — | — | — | 8.4 | — | — |
| * Leaves and stems of velvet beans, | 58.8 | 28.6 | — | — | — | — | — | — | — | — |
| Liliacæ : — | | | | | | | | | | |
| * Asparagus, | 942 | 3.3 | — | 3.29 | — | — | — | 1.08 | — | — |
| Asparagus, | 933 | 3.2 | 5.0 | 1.2 | .9 | .6 | .2 | .9 | .3 | .3 |
| Onions, | 860 | 2.7 | 7.4 | 2.5 | .2 | 1.6 | .3 | 1.3 | .4 | .2 |
| * Onions, | 892 | — | 4.9 | 1.8 | .1 | .4 | .2 | .7 | — | — |

Fertilizing Constituents of Garden Crops — Concluded.

| | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Phosphoric Acid. | Sulphuric Acid. | Chlorine. |
|-------------------------------------|-----------|-----------|-------|---------------------|---------------|-------------------|---------------------|---------------------|--------------------|-----------|
| Solanaceæ :— | | | | | | | | | | |
| Potatoes, | 750 | 3.4 | 9.5 | 5.8 | .3 | .3 | .5 | 1.6 | .6 | .3 |
| * Potatoes, | 798 | 2.1 | 9.9 | 2.9 | .1 | .1 | .2 | .7 | — | — |
| Potato tops, nearly ripe, | 770 | 4.9 | 19.7 | 4.3 | .4 | 6.4 | 3.3 | 1.6 | 1.3 | 1.1 |
| Potato tops, unripe, | 825 | 6.3 | 16.5 | 4.4 | .3 | 5.1 | 2.4 | 1.2 | .8 | .9 |
| * Tomatoes, | 940 | 1.7 | — | 3.6 | — | .3 | .2 | .4 | — | — |
| Tobacco leaves, | 180 | 34.8 | 140.7 | 40.7 | 4.5 | 50.7 | 10.4 | 6.6 | 8.5 | 9.4 |
| * Tobacco, whole leaf, | 103.1 | 24.3 | — | 57.9 | 24.7 | 45.8 | 13.8 | 4.3 | 16.3 | 1.59 |
| Tobacco stalks, | 180 | 24.6 | 64.7 | 28.2 | 6.6 | 12.4 | .5 | 9.2 | 2.2 | 2.4 |
| * Tobacco stems, | 106 | 22.9 | 140.7 | 64.6 | 3.4 | 38.9 | 12.3 | 6.0 | — | — |

| | | | | | | | | | | | | | | | | |
|-------------------|---|---|---|---|---|---|-----|------|-------|------|------|------|-----|-----|-----|-----|
| Umbelliferae : — | | | | | | | | | | | | | | | | |
| Carrots, | . | . | . | . | . | . | 850 | 2.2 | 8.2 | 3.0 | 1.7 | .9 | .4 | 1.1 | .5 | .4 |
| * Carrots, | . | . | . | . | . | . | 898 | 1.5 | 9.2 | 5.1 | .6 | .7 | .2 | .9 | — | — |
| Carrot tops, | . | . | . | . | . | . | 822 | 5.1 | 23.9 | 2.9 | 4.7 | 7.9 | .8 | 1.0 | 1.8 | 2.4 |
| Carrot tops, dry, | . | . | . | . | . | . | 98 | 31.3 | 125.2 | 48.8 | 40.3 | 20.9 | 6.7 | 6.1 | — | — |
| Parsnips, | . | . | . | . | . | . | 793 | 5.4 | 10.0 | .4 | .2 | 1.1 | .6 | 1.9 | .5 | .4 |
| * Parsnips, | . | . | . | . | . | . | 803 | 2.2 | — | 6.2 | .1 | .9 | .5 | 1.9 | — | — |
| Celery, | . | . | . | . | . | . | 841 | 2.4 | 17.6 | 7.6 | — | 2.3 | 1.0 | 2.2 | 1.0 | 2.8 |

Many of the foregoing analyses were compiled from the tables of E. Wolff. Those marked with a star (*) are from analyses made at the Massachusetts State Agricultural Experiment Station, Amherst, Mass., and since 1895, at the chemical division of the Hatch Experiment Station of the Massachusetts Agricultural College.

3. RELATIVE PROPORTIONS OF PHOSPHORIC ACID, POTASSIUM OXIDE AND NITROGEN IN FRUITS AND GARDEN CROPS.

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|-------------------------------|---------------------|---------------------|-----------|
| <i>Fruits.</i> | | | |
| Ericaceæ : — | | | |
| * Cranberries, | 1 | 3.0 | — |
| * Cranberries, | 1 | 3.33 | 2.66 |
| Rosaceæ : — | | | |
| Apples, | 1 | 2.7 | 2.0 |
| * Apples, | 1 | 1.9 | 1.3 |
| * Peaches, | 1 | 1.3 | — |
| Pears, | 1 | 3.6 | 1.2 |
| Strawberries, | 1 | 1.4 | — |
| * Strawberries, | 1 | 2.6 | — |
| * Strawberry vines, | 1 | .7 | — |
| Cherries, | 1 | 3.3 | — |
| Plums, | 1 | 4.3 | — |
| Saxifragaceæ : — | | | |
| * Currants, white, | 1 | 2.8 | — |
| * Currants, red, | 1 | 2.1 | — |
| Gooseberries, | 1 | 1.9 | — |

3. *Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — Continued.*

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|-----------------------------------|---------------------|---------------------|-----------|
| <i>Fruits — Con.</i> | | | |
| Viticeæ : — | | | |
| Grapes, | 1 | 3.6 | 1.2 |
| Grape seed, | 1 | 1.0 | 2.7 |
| <i>Garden Crops.</i> | | | |
| Chenopodiaceæ : — | | | |
| Mangolds, | 1 | 6.0 | 2.3 |
| * Mangolds, | 1 | 4.2 | 2.1 |
| Mangold leaves, | 1 | 4.5 | 3.0 |
| Sugar beets, | 1 | 4.2 | 1.8 |
| * Sugar beets, | 1 | 4.8 | 2.2 |
| Sugar beet tops, | 1 | 2.3 | 1.7 |
| Sugar beet leaves, | 1 | 5.7 | 4.3 |
| Sugar beet seed, | 1 | 1.5 | — |
| * Red beets, | 1 | 4.1 | 3.3 |
| Spinach, | 1 | 1.7 | 3.1 |
| * Spinach, | 1 | 19.2 | 6.8 |
| Compositæ : — | | | |
| Lettuce, common, | 1 | 5.3 | — |
| Head lettuce, | 1 | 3.9 | 2.2 |
| * Head lettuce, | 1 | 7.7 | 4.0 |
| Roman lettuce, | 1 | 2.3 | 1.8 |
| Artichoke, | 1 | .63 | — |
| * Artichoke, Jerusalem, | 1 | 2.8 | 2.7 |

3. *Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — Continued.*

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|-----------------------------------|---------------------|---------------------|-----------|
| <i>Garden Crops — Con.</i> | | | |
| Convolvulaceæ : — | | | |
| Sweet potato, | 1 | 4.6 | 3.0 |
| Cruciferae : — | | | |
| White turnips, | 1 | 3.6 | 2.3 |
| * White turnips, | 1 | 3.9 | 1.8 |
| White turnip leaves, | 1 | 3.1 | 3.3 |
| * Ruta-bagas, | 1 | 4.1 | 1.6 |
| Savoy cabbage, | 1 | 1.9 | 2.5 |
| White cabbage, | 1 | 4.1 | 1.7 |
| * White cabbage, | 1 | 11.0 | 7.6 |
| Cabbage leaves, | 1 | 4.1 | 1.7 |
| Cauliflower, | 1 | 2.3 | 2.5 |
| Horse-radish, | 1 | 3.9 | 2.2 |
| Radishes, | 1 | 3.2 | 3.8 |
| Kohlrabi, | 1 | 1.6 | 1.8 |
| Cucurbitaceæ : — | | | |
| Cucumbers, | 1 | 2.0 | 1.3 |
| Pumpkins, | 1 | .6 | .7 |
| Gramineæ : — | | | |
| Corn, whole plant, green, . . . | 1 | 3.7 | 1.9 |
| * Corn, whole plant, green, . . . | 1 | 2.2 | 2.8 |
| Corn kernels, | 1 | .6 | 2.8 |
| * Corn kernels, | 1 | .6 | 2.6 |

3. *Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — Continued.*

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|---|---------------------|---------------------|-----------|
| <i>Garden Crops — Con.</i> | | | |
| Gramineæ — <i>Con.</i> | | | |
| * Corn, whole ears, | 1 | .8 | 2.5 |
| * Corn stover, | 1 | 4.4 | 3.7 |
| Leguminosæ : — | | | |
| Hay of peas, cut green, | 1 | 3.4 | 3.4 |
| * Cow-pea (<i>Dolichos</i>), green, | 1 | 3.1 | 2.9 |
| * Small pea (<i>Lathyrus Sylvestris</i>), dry. | 1 | 3.4 | 4.2 |
| Peas, seed, | 1 | 1.2 | 4.3 |
| Pea straw, | 1 | 2.8 | 4.0 |
| Garden beans, seed, | 1 | 1.2 | 4.0 |
| Bean straw, | 1 | 3.3 | — |
| * Velvet beans, kernel, | 1 | 1.7 | 4.0 |
| * Velvet beans, with pod, | 1 | 1.56 | 2.3 |
| * Leaves and stems of velvet beans, | — | — | — |
| Liliaceæ : — | | | |
| * Asparagus, | 1 | 3.05 | 3.06 |
| Asparagus, | 1 | 1.3 | 3.6 |
| Onions, | 1 | 1.9 | 2.1 |
| * Onions, | 1 | 2.6 | — |
| Solanaceæ : — | | | |
| Potatoes, | 1 | 3.6 | 2.1 |
| * Potatoes, | 1 | 4.1 | 3.0 |
| Potato tops, nearly ripe, | 1 | 2.7 | 3.1 |

3. *Relative Proportions of Phosphoric Acid, etc., in Fruits and Garden Crops — Concluded.*

| | Phosphoric Acid. | Potassium Oxide. | Nitrogen. |
|--------------------------------|---------------------|---------------------|-----------|
| <i>Garden Crops — Con.</i> | | | |
| <i>Solanaceæ — Con.</i> | | | |
| Potato tops, unripe, | 1 | 3.7 | 5.3 |
| * Tomatoes, | 1 | 8.7 | 4.5 |
| Tobacco leaves, | 1 | 6.2 | 5.3 |
| * Tobacco, whole leaf, | 1 | 13.46 | 5.65 |
| Tobacco stalks, | 1 | 3.1 | 2.7 |
| * Tobacco stems, | 1 | 10.7 | 3.8 |
| <i>Umbelliferae : —</i> | | | |
| Carrots, | 1 | 2.7 | 2.0 |
| * Carrots, | 1 | 5.7 | 1.7 |
| Carrot tops, | 1 | 2.9 | 5.1 |
| Carrot tops, dry, | 1 | 8.0 | 5.1 |
| Parsnips, | 1 | 3.8 | 2.8 |
| * Parsnips, | 1 | 3.3 | 1.2 |
| Celery, | 1 | 3.5 | 1.1 |

4. ANALYSES OF INSECTICIDES.

| | Moisture. | Arsenious Oxide. | Copper Oxide. | Lead Oxide. | Zinc Oxide. | Barium Oxide. | Acetic Acid. | Nicotine. | Mercury. | Sulphur. | Sulphuric Acid. | Chlorine. | Calcium Oxide. | Potassium Oxide. | Ferric and Aluminic Oxides. | Insoluble Matter in Hydrochloric Acid. |
|--|-----------|------------------|---------------|-------------|-------------|---------------|--------------|-----------|----------|----------|-----------------|-----------|----------------|------------------|-----------------------------|--|
| Average of twelve analyses, Paris green, . . . | 1.22 | 57.91 | 32.08 | - | - | - | 4.74 | - | - | - | - | - | - | - | - | .20 |
| Average of four analyses, "Lion brand new-process Paris green," | 4.64 | 54.91 | 7.93 | - | - | - | - | - | - | - | 6.65 | - | 15.76 | .35 | - | 1.00 |
| Average of fourteen analyses of Paris green collected in the general markets in 1900-1901. | .81 | 57.73 | 29.45 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Pink arsenoid (lead arsenite), | .35 | 40.16 | - | 53.83 | - | - | - | - | - | - | - | - | - | - | - | - |
| Green arsenoid (copper arsenite), | 1.44 | 50.77 | 31.90 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| White arsenoid (barium arsenite), | 2.35 | 31.90 | - | .96 | - | 48.31 | - | - | - | - | - | 3.19 | - | - | - | - |
| Laurel green, | 7.64 | 7.34 | 13.50 | - | - | - | - | - | - | - | - | - | 26.31 | - | - | - |
| Bug death, | .03 | - | - | 1.58 | 78.86 | - | - | - | - | - | - | - | - | - | 3.80 | - |
| Sulphatine, | 1.40 | - | 2.61 | - | - | - | - | - | - | 48.28 | 4.73 | - | 18.60 | - | - | 1.63 |
| Death to rose bugs, | 2.95 | - | 1.05 | - | - | - | - | - | - | 34.53 | 4.35 | - | 17.76 | - | - | .49 |
| Professor De Graff's carpet bug destroyer, | 95.81 | - | - | - | - | - | - | - | .78 | - | .48 | .27 | - | .26 | .90 | - |
| Oriental fertilizer and bug destroyer, | 87.14 | 2.38 | - | - | - | - | - | - | - | - | .64 | 3.00 | - | 3.50 | - | - |
| Non-poisonous potato bug destroyer, | - | - | - | - | - | - | - | - | - | - | - | - | 68.20 | - | 1.38 | 1.50 |
| Tobacco liquor, | 37.71 | - | - | - | - | - | - | 2.12 | - | - | - | - | 3.07 | 6.55 | .23 | - |
| Tobacco liquor, | 40.89 | - | - | - | - | - | - | .53 | - | - | - | - | 1.47 | 16.34 | .01 | - |
| Tobacco liquor, | - | - | - | - | - | - | - | 4.08 | - | - | - | - | - | - | - | - |
| Nicotina, | 10.00 | - | - | - | - | - | - | - | - | - | - | - | 4.45 | 9.15 | - | 2.12 |
| Hellebore, | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.34 |
| Hellebore, | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 38.12 |
| Peroxide of silicate, | 1.65 | .57 | .33 | - | - | - | - | - | - | - | 49.66 | - | 41.18 | - | - | 2.31 |

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Assistants: E. B. HOLLAND, P. H. SMITH, JR., J. W. KELLOGG.

PART I. — OUTLINE OF YEAR'S WORK.

- A. Correspondence.
- B. Extent of chemical work.
- C. Character of chemical work.
 - (a) Water.
 - (b) Dairy products and feed stuffs.
 - (c) Chemical investigation.
- D. Cattle feed inspection.
- E. Dairy legislation.
- F. Miscellaneous.

PART II. — DAIRY AND FEEDING EXPERIMENTS.

- A. Effect of feed on the composition of milk, butter fat, and on the consistency or body of butter.
- B. Notes on summer forage crops.

PART III. — COMPILATIONS.

- A. Composition and digestibility of fodder articles.
- B. Fertilizer ingredients of fodder articles.
- C. Analyses of dairy products.
- D. Coefficients of digestibility of American feed stuffs.

PART I.—OUTLINE OF YEAR'S WORK.

J. B. LINDSEY.

A. CORRESPONDENCE.

The general correspondence of this division has increased considerably during the last five years, due especially to the establishment of the feed control, and to the work in connection with the dairy law. More than the usual number of inquiries have been received relative to milk, cream, water, feed stuffs and methods of feeding. Some letters can be answered very quickly, while others require time and study. The total number of letters written during the year ending December 15 has been 2,186.

B. EXTENT OF CHEMICAL WORK.

In the last report attention was called to the fact that the ever-increasing demand on the chemists' time for work of a routine character—the analyses of water, milk, cream and feed stuffs—very seriously interfered with the extent of experimental work. This has been particularly the case the past year, due largely to the amount of time required in connection with the dairy law. In fact, the work of investigation has been seriously curtailed, which is much to be regretted.

There have been sent in for examination 242 samples of water, 164 of milk, 1,557 of cream, 15 of pure and process butter, 48 of oleomargarine, 106 of feed stuffs and 5 of miscellaneous substances. In connection with experiments by this and other divisions of the station, there have been analyzed, in whole or in part, 148 samples of milk and cream, 80 of butter fat and 563 of fodders and feed stuffs.

There have also been collected, under the provision of the feed law, and tested, either individually or in composite, 694 samples of concentrated feed stuffs. This makes a total of 3,622 substances analyzed during the year, as against 3,036 last year and 2,045 in the previous year. Work on the pentosans and galactan, not included in the above, has been done for the Association of Official Agricultural Chemists. In addition, forty-five candidates have been examined and given certificates to operate Babcock machines in creameries and milk depots, and 5,041 pieces of glassware have been tested for accuracy.

C. CHARACTER OF CHEMICAL WORK.

(a) *Water*.—It has been the custom, ever since the establishment of the Massachusetts State Experiment Station, in 1882, to make sanitary analyses of drinking waters free of cost to all citizens of Massachusetts. Work of this character has increased until it has become quite burdensome. Acting with the approval of the Experiment Station committee, the following rules were adopted, and went into effect July 1:—

1. Hereafter, all parties wishing to secure a sanitary analysis of water at the Hatch Experiment Station must make known their desire by postal or letter, whereupon a glass bottle, securely encased, accompanied by full instructions for collecting and shipping the sample, will be forwarded by express to the applicant.

2. According to a recent official ruling, no party shall be allowed to have more than *two* samples of water tested at this station free of cost in a single month. Additional analyses may be obtained within this time at a cost of two dollars each, providing the resources of the station permit.

Heretofore, parties have been allowed to send in any number of samples, at any time, in any kind of vessel. One result of this custom was, that the station often received more samples than could be properly handled, and other work was crowded to one side. Now it is possible to regulate the number of samples by the time at our disposal. Because of the large amount of work on hand, it has become

necessary to refuse water samples during the months of November and December of the present year. Again, many persons had only an imperfect understanding of the method of taking and shipping a sample; consequently, the water was often received in improper condition, rendering the results of very questionable value. At present, a clean, glass-stoppered bottle is shipped the applicant, together with full instructions. The chemist, therefore, feels reasonably sure that the sample under examination is a fair one, and the results obtained are of a more positive character.

Samples are received not only from farmers, but from persons following various trades and professions. They are practically all from wells, springs and ponds in towns and villages not having a public water supply. Many are of fair quality, others quite suspicious, while some are entirely unfit for use. Some samples have been found to contain lead, due to the use of lead pipe. Drinking water thus polluted results in serious cases of lead poisoning, as many persons have found, to their sorrow. All parties are *cautioned never to use lead pipe to conduct water intended for drinking or cooking purposes*. It is not considered necessary to publish the results of the various analyses made, as they convey no particular information that could be of general interest.

(b) *Dairy Products and Feed Stuff's*.—More than the usual number of samples of milk and cream have been received during the past year. They were sent largely for the purpose of determining the amount of butter fat they contained. Some farmers are desirous of knowing the quality of milk produced by their animals, while others, who sell cream to the different creameries, wish to ascertain how closely the station tests agree with those made by the local creamery. Quite frequently samples of milk are received from milkmen whose product has been found to be below the standard by the inspector or milk contractor. In such cases the determination of both total solids and fat is made. The results of all analyses are returned within a few days, together with as full information as possible.

Printed circulars are also sent, containing information concerning the quality of the milk produced by different breeds of animals, and the necessary instruction relative to the best methods to be used in estimating the butter producing capacity of dairy herds.

In addition to the above, this division examines milk, cream and butter collected in western Massachusetts by the agent of the Dairy Bureau. The work is confined largely to the detection of oleomargarine, and is paid for by the Bureau, at a definite price for each determination.

The number of feed stuffs sent for examination was a trifle less than usual, due to the fact that quite thorough information of this character is now furnished in the feed bulletins issued from time to time by this division. During the winter and early spring a considerable number of samples of cotton-seed meal were received, tested, and the results returned without delay.

(c) *Chemical Investigation.* — So far as possible, it is the intention of this division to continue its investigation of some of the various dairy and feeding problems demanding solution. At present the time is devoted to the examination of butter fat, the manufacture of butter, and the digestibility of concentrated feed stuffs and summer forage crops. Work of this character is to be found in connection with Part II. of this report.

D. CATTLE FEED INSPECTION.

The inspection of cattle feeds has been carried on in much the same manner as in previous years. Bulletin No. 71, comprising forty pages, was issued early in the year. This contains analyses of 653 cattle feeds, 33 poultry feeds, 46 so-called condimental foods for horses, cattle and poultry, together with full discussion of the results obtained. The interested reader is referred to it. When warranted, additional information is issued as press bulletins and sent to about one hundred newspapers in the State. Should any material be found seriously adulterated, a special circular is sent at once to the grain dealers in every town. Two complete inspections have been made during the present year, resulting in the collection of 698 samples. They are now

under examination, and the results thus far obtained allow the following deductions : —

(a) The larger part of the *cotton-seed meal* is now guaranteed, and is of excellent quality. A few unguaranteed meals were found mixed with more or less hulls. *Farmers are strongly urged to buy only guaranteed meals.*

(b) *Gluten meal* and *feed* are nearly always accompanied with a guaranty, and are free from any foreign admixtures.

(c) *Wheat bran* and *middlings* are seldom adulterated. Purchasers are recommended, however, to give preference to those articles branded with the name of reputable manufacturers, or to examine the article closely before buying, in order to note its quality.

(d) *Mixed feed*, so called, consists of the entire wheat offal or mixtures of bran, coarse and flour middlings. The larger the proportion of flour middlings, the more valuable the feed. Different brands show noticeable variations in the proportions of the several ingredients. Farmers can obtain a very *desirable* mixed feed by mixing equal parts by weight of bran and flour middlings or red dog flour. Such a feed will be decidedly preferable to many of the brands now on the market, and the cost will not be increased. Most mixed feeds are entirely free from adulteration. A few samples were found containing a considerable quantity of ground corn cobs. Some were marked Kentucky Milling Company, others Kentucky, and a few were without brand. Several samples contained a noticeable amount of wheat screenings. Mixed feed containing cobs can generally be recognized by the hard, woody nature of the material when chewed. A close inspection of the feed will reveal the presence of screenings. Consumers are *especially cautioned* against such feeds.

(e) Oat offal, the refuse from the oat meal mills, contains large quantities of oat hulls. Two brands, namely, "X" and "Boston," were practically all hulls. The price of the offal varied from \$16 to \$27 a ton. It is relatively a *very expensive feed*.

(f) Dried brewers' grains and malt sprouts offer cheap sources of protein, provided they can be obtained.

In general, it can be said that the number of brands is

increasing each year, practically all of which are the by-products from different manufacturing industries. The better class of feed stuffs, as put out by firms of established reputation, are not adulterated ; irresponsible firms, however, are making systematic attempts to put out inferior goods. This is noticed especially in the persistent attempt to sell cotton-seed meal mixed with fine-ground hulls for genuine meal ; in the substitution of fine-ground corn cobs for middlings in mixed feeds ; in the offering of fine-ground rice hulls to dealers for the purpose of adulterating standard grains ; and in the use of oat offal rather than ground oats in the mixing of the so-called provender (cracked corn and ground oats).

The following is the text of the present feed stuff law : —

[CHAPTER 117, ACTS AND RESOLVES OF 1897.]

SECTION 1. The director of the Hatch Experiment Station of the Massachusetts Agricultural College is hereby authorized and directed, in person or by deputy, to take samples not exceeding two pounds in weight from any lot or package of concentrated commercial feed stuff, used for feeding any kind of farm live stock, which may be in the possession of any manufacturer, importer, agent or dealer, cause the same to be analyzed for the amount of crude protein and crude fat contained therein, as well as for other ingredients if thought advisable, and cause the results of the analyses to be published from time to time in especially prepared bulletins, with such additional information as circumstances advise: *provided, however*, that in publishing the results of the analyses, the name of the jobbers or local dealers selling the said feed stuffs shall not be used, but the commodity analyzed shall be identified and described by the name of the manufacturer, or the commercial name or designation by which it is known in the trade.

SECTION 2. Whenever requested, said samples shall be taken in the presence of the party or parties in interest or their representative, and shall in all cases be taken from a parcel or number of packages which shall not be less than five per cent. of the whole lot inspected, shall be thoroughly mixed and then divided into two equal samples and put in glass vessels and carefully sealed, and a label placed on each vessel stating the name or brand of the feed stuff or material sampled, the name of the manufacturer when possible, the name of the party from whose

stock the sample was taken, and the time and place of taking; said label shall be signed by the director, or his deputy, and by the party or parties in interest or their representative if present at the taking and sealing of the samples. One of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled.

SECTION 3. To defray the expenses of collecting and analyzing the samples and of publishing the results, the sum of twelve hundred dollars shall be allowed and paid annually in semi-annual payments from the treasury of the Commonwealth into the treasury of the Massachusetts Agricultural College.

SECTION 4. This act shall take effect on the first day of July in the year eighteen hundred and ninety-seven.

The above law simply provides for collecting and analyzing the samples and for the publication of the results. It prevents the publication of the names of the jobbers or local dealers selling the feed stuffs. It was the best that could be procured at the time. In the light of our experience, it is believed that this law should be changed and a more comprehensive one made, with the following points emphasized:—

1. An explicit statement of those feed stuffs included and those not included within the law.

2. The tagging of each package with the brand, name and place of business of the manufacturer or sponsor, net weight, and a guaranty of protein, fat and fibre.

3. The prohibiting of adulteration of any grain or recognized by-product with any foreign material whatsoever, unless the name and quantity of said material is clearly specified on the package.

4. The filing upon request by each manufacturer of a certified sample of each distinct brand of feed stuff offered for sale.

5. Instructions concerning the collection and analyzing of the feed stuffs and the publication of the results.

6. A penalty for obstructing an agent in the collecting of samples, and for selling articles which are not as represented.

7. The appropriation from the State treasury of at least double the sum now appropriated for the purpose of carrying out the provisions of the new law.

Laws similar to the one outlined are now in operation in Maine, New Hampshire, Vermont, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Maryland and Wisconsin. It is believed that the enactment of a law including the points outlined above would be for the true interest of producers and consumers alike.

E. DAIRY LEGISLATION.

The Massachusetts Legislature during the session of 1901-1902 passed the following law : —

[CHAPTER 202.]

AN ACT TO PROVIDE FOR THE PROTECTION OF DAIRYMEN.

Be it enacted, etc., as follows :

SECTION 1. All bottles, pipettes or other measuring glasses used by any person, firm or corporation, or by any employee or agent thereof, at any creamery, cheese factory, condensed milk factory, milk depot, or other place, in this state, in determining by the Babcock test, or by any other test, the value of milk or cream received from different persons or associations at such creameries, factories or milk depots as a basis of payment for such milk or cream, shall before use be tested for accuracy. Such bottles, pipettes or measuring glasses shall bear in ineffaceable marks or characters the evidence that such test has been made by the authority named in section two of this act. No inaccurate bottles, pipettes or glasses shall bear such marks or characters, but when found inaccurate shall be marked “Bad.”

SECTION 2. It is hereby made the duty of the director of the Hatch Experiment Station of the Massachusetts Agricultural College, or of some competent person designated by him, to test all bottles, pipettes or other measuring glasses, as required by section one of this act. The director of the experiment station shall receive for such service the amount of the actual cost incurred, and no more, the same to be paid by the persons or corporations for whom it is rendered.

SECTION 3. Within six months after this act takes effect, and once each year thereafter, the director of the Hatch Experiment Station, or his authorized agent, shall inspect at the expense of the owners all centrifugal or other machines used by any person, firm or corporation, or by any agent or employee thereof, for the testing of milk or cream in fixing the value thereof ; and the director of the experiment station or his authorized agent shall cause all

such machines to be put into condition to obtain accurate results with the Babcock test or other tests, at the expense of the owners thereof. Such machines may be replaced by new ones at the option of the persons to whom they belong.

SECTION 4. No person shall, either by himself or in the employ of any other person, firm or corporation, manipulate the Babcock test, or any other test, whether mechanical or chemical, for the purpose of measuring the butter fat contained in milk or cream as a basis for determining the value of such milk or cream, or of butter or cheese made from the same, without first obtaining a certificate from the director of the Hatch Experiment Station that he or she is competent to perform such work. Rules governing applications for such certificates and the granting of the same shall be established by the said director. The fee for issuing such a certificate shall in no case exceed two dollars, the same to be paid by the applicant to the said director, to be used in meeting the expenses incurred under this act.

SECTION 5. It shall be the duty of the director of the Hatch Experiment Station to test farmers' samples of milk or cream by the Babcock method, and report the results of each test, the cost of such test to be paid by the farmer. The director shall also test by the Babcock method, samples of milk or cream sent from any creamery, factory or milk depot in the state by its proper representative, the actual cost of such tests to be borne by the sender. The experiment station shall publish and distribute such information concerning the Babcock test, and the taking and forwarding of samples, as it deems necessary under this section.

SECTION 6. Any person violating any provision of this act shall be fined not more than twenty-five dollars for the first offence and not more than fifty dollars for each subsequent offence.

SECTION 7. This act shall take effect on the first day of July in the year nineteen hundred and one. [*Approved March 26, 1901.*]

The execution of the above law having been referred to this division, a circular was prepared, giving the text of the law, together with such rules and regulations as it seemed wise to make for the carrying out of its several provisions. There seeming to be doubt in some instances as to whom the law applied, the following interpretation was made, which is believed to be correct and in accordance with the spirit of the law : —

1. All parties employing the Babcock or similar test

simply as a protection against adulteration, the results of which in no way affect the price of milk or cream to either the producer or consumer, shall be considered exempt from the law.

2. All parties employing the Babcock or similar test (as described in section 4) for the purpose of measuring the butter fat contained in the milk or cream, as a basis for determining or fixing the value of such milk or cream (to either producer or purchaser), shall be considered subject to the requirements of the law.

The law practically resolves itself into three sections: (1) the testing of glassware for accuracy of graduation; (2) the examination of candidates for proficiency in operating the test; (3) the inspection of Babcock machines.

Inspection of Glassware. — The scale on the neck of the cream, whole and skim milk bottles is tested for accuracy of graduation by the mercury method, as described by Farrington & Woll in their work entitled “Testing milk and its products.” Pipettes and acid measures are tested for accuracy by carefully measuring the amount of water they deliver. The following limits of error were adopted: —

| | Capacity. | Single Graduation. | Limit of Error. |
|--|----------------------------|------------------------|--------------------------|
| | Per Cent. 30-35-40 | Per Cent. .50 | Per Cent. .50 |
| Cream bottles, Connecticut, | 50 | 1.00 | .50 |
| Cream bottles, Bartlett, | 25 | .20 | .20 |
| Milk bottles, common, | 10 | .20 | .20 |
| Milk bottles, Ohlsson, | 5 | .10 | .10 |
| Milk bottles, Wagner, | 8 | .10 | .10 |
| Skim milk bottles, double quantity, | 2.00 | .10 | .10 |
| Skim milk bottles, Ohlsson, | .50 | .05 | .02 |
| Skim milk bottles, improved Ohlsson, | .25 | .01 | .01 |
| Skim milk bottles, Wagner, | .50 | .05 | .02 |
| Skim milk bottles, improved Wagner, | .25 | .01 | .10 |
| Pipettes, cream, | Cubic Centimetre. 18.00 | Cubic Centimetre. — | Cubic Centimetre. .10 |
| Pipettes, milk, | 17.60 | — | .10 |
| Acid measures, | 17.50 | — | .20 |

All glassware found to be correct is marked "Mass. Ex. St.," by means of a sand blast, working under twenty-five pound pressure. The necessary air pressure for the blast is obtained by a double-acting power air pump,* with a thirty-gallon reservoir.

It became necessary at first to test the ware in use by all creameries and milk depots. Now, practically none is received from these sources, but rather from the large supply houses, who furnish tested ware whenever requested. There has been examined to date 5,041 pieces, of which 291 pieces, or 5.77 per cent., have been found to be incorrect. One order from a large supply house, numbering 441 pieces, contained 149 pieces, or 33.8 per cent., incorrectly graduated. The wisdom, therefore, of this section of the law is apparent without further argument.

Manufacturers are now inclined to be more careful concerning the quality and accuracy of glassware supplied, for the reason that a large part is examined by the several experiment stations before coming into the hands of the users.

Examination of Candidates.† — It seemed wise to require candidates to present themselves at the station laboratory for examination. In all, 45 candidates have been examined to date. Scarcely any were found to be free from faults, but the larger number appeared to understand the general principles of manipulation. A few were noticeably careless, and had but an imperfect understanding of the process. As much instruction as possible was given in the time at our disposal, an especial effort being made to correct the serious faults. In furtherance of this idea, the following circular concerning the points especially to be observed in making the test was printed, and a copy given to each party examined : —

1. Milk or cream should be carefully and thoroughly mixed, — *never* by shaking the sample, but by gently rotating it and by pouring from one vessel to another. All cream adhering to the

* No. 3, A. Babcock & Bishop Company, New York.

† The inspection of the glassware and the examination of candidates were largely in charge of Mr. E. B. Holland, who gave these matters very careful attention.

sides and stopper of the retaining vessel must be incorporated, and the resulting mixture should show no solid particles of fat. A small fine wire sieve is of great value in detecting the imperfect (lumpy) condition of a sample and in preparing the same for pipetting.

2. Pipette immediately after preparing the sample, filling the pipette *slowly*, and taking care to avoid air bubbles. Hold the pipette in a *vertical* position when lowering the liquid to the mark, and always read with the entire meniscus above the line. In transferring milk or cream to the test bottles, avoid, so far as possible, the smearing of the entire neck with the liquids.

3. Cream testing above 25 per cent. of fat should always be weighed, as accurate results cannot be secured with the pipette.

4. In adding the acid, turn the bottle so as to wash down all milk or cream adhering to the sides of the neck, and mix at once. Rotate the bottle until all the lumps of casein are thoroughly dissolved, and the resulting mixture is *black* in color. Never slight the mixing, and avoid throwing the fat up into the neck.

5. Whirl at least five, two, and two minutes. In filling with hot water, allow the water to run down the sides of the neck, and thus avoid stirring up the contents of the bottle.

6. In reading the column of fat, it is safer to use a pair of dividers than to trust to the unaided eye; read the *centre* of the fat column from the *lowest* to the *highest* limit.

Inspection of Machines. — The inspection of Babcock machines, in accordance with section 3 of the law, is now in progress. Mr. Nathan J. Hunting, a graduate of the college in the class of 1901, is charged with the execution of this work. It is not possible at present to make any definite report, other than to state that a number of machines have thus far been condemned and others have been ordered repaired.

F. MISCELLANEOUS.

Under this heading it is desired to call attention to the compilation of analyses of cattle feeds and dairy products prepared by Messrs. Holland and Smith, and published as Part III. Tables of a similar character were printed in the ninth report of this station. The present compilation — representing the analysis of different substances made since the establishment of the Massachusetts State Experiment

Station — has been thoroughly revised, and some feeds that are no longer on the market or were of only temporary interest have been omitted. This is especially true of a number of concentrated by-products, where the process of manufacture has been noticeably changed and improved.

Tables showing the coefficients of digestibility of all American feed stuffs, similar to those published in the ninth report, are also presented. Work of this nature requires a great amount of time, and severely taxes the resources of the station staff.

PART II. — DAIRY AND FEEDING EXPERIMENTS.

J. B. LINDSEY.*

A. EFFECT OF FEED ON THE COMPOSITION OF MILK AND ON THE CONSISTENCY OR BODY OF BUTTER.

Experiments of this character have been in progress since 1898. A general outline of those previously completed will be found in the preceding (thirteenth) report of this station (pages 14–33).

During the autumn and winter of 1900–1901 another series was conducted, for the purpose of noting particularly the effect of cotton-seed meal with a minimum amount of oil, and likewise with the addition of cotton-seed oil, on the relative proportions of the several ingredients in milk and butter fat and on the body of the butter. It is intended at present only to briefly outline the character of the experiment, and to call attention to a few of the more important facts; the full data will be published later.

Plan of Experiment. — Ten cows were divided into two herds of five each. During the first period both herds received the same or so-called standard ration. During the three subsequent periods Herd I. continued to receive the standard ration as in the first period, and in case of Herd II. a portion of the standard ration was replaced by cotton-seed meal, cotton-seed oil and Cleveland flax meal.

TABLE I. — *Duration of Experiment.*

| PERIODS. | Dates of Experiment. | Length in Weeks. |
|--|--------------------------|------------------|
| First period, both herds standard ration, . . | Nov. 17 through Dec. 7, | 3 |
| Second period, Herd II., cotton-seed ration, . . | Jan. 5 through Feb. 8, | 5 |
| Third period, Herd II., cotton-seed oil ration, . | Feb. 23 through April 6, | 6 |
| Fourth period, Herd II., Cleveland flax meal ration. | April 20 through May 16, | 4 |

* Together with E. B. Holland, P. H. Smith, Jr., and J. W. Kellogg.

TABLE II. — *Approximate Daily Rations (Pounds).**First period: both herds, standard ration.*

| HERDS. | Standard Ration. | Cotton-seed Meal. | Cotton-seed Oil. | Cleveland Flax Meal. | First Cut Hay. | Rowen. |
|-------------------|------------------|-------------------|------------------|----------------------|----------------|--------|
| Herd I., | 9 | — | — | — | 8-12 | 10 |
| Herd II., | 9 | — | — | — | 8-12 | 10 |

Second period: Herd I., standard ration; Herd II., cotton-seed ration.

| | | | | | | |
|-------------------|---|---|---|---|------|----|
| Herd I., | 9 | — | — | — | 8-12 | 10 |
| Herd II., | 5 | 3 | — | — | 8-12 | 10 |

Third period: Herd I., standard ration; Herd II., cotton-seed oil ration.

| | | | | | | |
|-------------------|---|---|----|---|------|----|
| Herd I., | 9 | — | — | — | 8-12 | 10 |
| Herd II., | 5 | 3 | .5 | — | 8-12 | 10 |

Fourth period: Herd I., standard ration; Herd II., Cleveland flax meal ration.

| | | | | | | |
|-------------------|---|---|---|---|------|----|
| Herd I., | 9 | — | — | — | 8-12 | 10 |
| Herd II., | 4 | — | — | 3 | 8-12 | 10 |

The standard ration consisted of 3 pounds of wheat bran, 5 pounds of ground oats and $\frac{1}{2}$ pound each of cotton-seed and gluten meal. It is not to be inferred that this so-called standard ration is superior to all other rations, but simply that it was thought to be a safe and desirable ration, and likely to produce normal milk and butter. It was intended to secure cotton-seed meal with a minimum percentage of oil, but, in spite of all efforts, the lowest obtainable contained 8 per cent. The extra cotton-seed oil fed in the third period was mixed with the grain ration.

TABLE III. — *Average Composition of Milk.**First period: both herds standard ration.*

| Herds. | Total Solids. | Fat. | Solids not Fat. | Nitrogen. | Ash. |
|---------------------|---------------|------|-----------------|-----------|------|
| Herd I., | 14.15 | 5.00 | 9.15 | .538 | .73 |
| Herd II., | 14.27 | 4.93 | 9.34 | .546 | .72 |

Second period: Herd I., standard ration; Herd II., cotton-seed ration.

| | | | | | |
|---------------------|-------|------|------|------|-----|
| Herd I., | 14.16 | 5.06 | 9.10 | .550 | .73 |
| Herd II., | 14.30 | 4.98 | 9.32 | .562 | .71 |

Third period: Herd I., standard ration; Herd II., cotton-seed oil ration.

| | | | | | |
|---------------------|-------|------|------|------|-----|
| Herd I., | 14.22 | 5.05 | 9.17 | .557 | .73 |
| Herd II., | 14.75 | 5.40 | 9.35 | .565 | .72 |

Fourth period: Herd I., standard ration; Herd II., Cleveland flax meal ration.

| | | | | | |
|---------------------|-------|------|------|------|-----|
| Herd I., | 14.32 | 5.12 | 9.21 | .565 | .74 |
| Herd II., | 14.81 | 5.06 | 9.75 | .616 | .74 |

Composite samples of milk were taken from each herd for five days in each week, and tested for total solids, fat, nitrogen and ash. The milk from each herd showed no noticeable variations in composition during the first two periods. In the third, or cotton-seed oil period, the milk of Herd I. remained as in the preceding periods, while the total solids and fat of Herd II. showed an increase of about .40 per cent. at the beginning of the period, and this increase maintained itself until the close of the period. The solids not fat, nitrogen and ash remained unchanged. In the fourth, or Cleveland flax meal period, the milk from Herd I. remained practically unchanged, increasing a trifle in all ingredients, due to advanced lactation. In case of the milk from Herd II. the fat decreased to the percentage produced in the second period (before the cotton-seed oil was fed),

while the total solids remained as high as in the cotton-seed oil period. The solids not fat and the nitrogen showed a noticeable increase. The increase of the nitrogen percentage apparently explains why the total solids did not show the same relative decrease as did the total fat. The ash remained unaffected.

TABLE IV. — *Average Analysis of Butter Fat.*

First period: both herds standard ration.

| NUMBER SAMPLES, EACH HERD. | SAPONIFI- CATION EQUIVA- LENT. | | INSOLUBLE ACIDS. | | REICHERT MEISSEL NUMBER. | | MELTING POINT (DEGREES C.). | | IODINE NUMBER. | |
|----------------------------------|---|-------------|---------------------|-------------|--------------------------------|-------------|-----------------------------------|-------------|-------------------|-------------|
| | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. |
| 6 samples, . | 229.3 | 231.8 | 88.95 | 88.72 | 29.02 | 30.54 | 33.44 | 32.46 | 28.28 | 29.29 |

Second period: Herd I., standard ration; Herd II., cotton-seed meal ration.

| | | | | | | | | | | |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 10 samples, . | 228.7 | 230.3 | 88.03 | 87.81 | 29.08 | 30.32 | 33.75 | 34.10 | 27.98 | 29.58 |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

Third period: Herd I., standard ration; Herd II., cotton-seed oil ration.

| | | | | | | | | | | |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 12 samples, . | 233.3 | 225.3 | 88.19 | 88.57 | 28.97 | 28.82 | 34.04 | 36.46 | 27.35 | 33.78 |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

Fourth period: Herd I., standard ration; Herd II., Cleveland flax meal ration.

| | | | | | | | | | | |
|--------------|-------|-------|---|---|-------|-------|-------|-------|-------|-------|
| 8 samples, . | 228.9 | 228.4 | - | - | 28.08 | 26.81 | 34.04 | 33.42 | 29.21 | 29.87 |
|--------------|-------|-------|---|---|-------|-------|-------|-------|-------|-------|

It will be seen that, excepting for minor variations, the butter fat produced by Herd I. remained unchanged throughout the several periods. In the cotton-seed meal period the fat produced by Herd II. increased a little in its melting point, but otherwise no particular change is noted. In the cotton-seed oil period the fat in case of Herd II. showed a decrease in its Reichert Meissl number and a noticeable increase in the melting point and iodine number, as compared with previous periods. In the Cleveland flax meal period the butter fat produced by Herd II. became similar in composition to that produced by Herd I., excepting the Reichert

Meissl number, which somewhat decreased. This decrease in volatile acids was also noticed in a previous experiment, when linseed meal was fed with apparently unsatisfactory results, so far as the quality of the butter was concerned.

Two lots of butter were made weekly, the same conditions prevailing in case of each herd. These butters were scored by W. A. Gude of New York and O. Douglass of Boston : —

TABLE V. — *Average Butter Scores.*

First period : both herds standard ration.

| SCORERS. | FLAVOR. | | BODY. | | COLOR. | | SALT. | | STYLE. | | TOTAL. | |
|-------------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|---------|----------|
| | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. |
| Gude, . | 36.5 | 38.0 | 24.8 | 24.6 | 15.0 | 15.0 | 10 | 10 | 5 | 5 | 91.3 | 92.6 |
| Douglass, . | - | - | - | - | - | - | - | - | - | - | 93.6 | 93.7 |

Second period : Herd I., standard ration ; Herd II., cotton-seed meal ration.

| | | | | | | | | | | | | |
|-------------|------|------|------|------|------|------|----|----|---|---|------|------|
| Gude, . | 36.8 | 37.3 | 24.5 | 24.8 | 14.9 | 14.8 | 10 | 10 | 5 | 5 | 91.2 | 91.9 |
| Douglass, . | - | - | - | - | - | - | - | - | - | - | 93.8 | 94.1 |

Third period : Herd I., standard ration ; Herd II., cotton-seed oil ration.

| | | | | | | | | | | | | |
|-------------|------|------|------|------|------|------|----|----|---|---|------|------|
| Gude, . | 36.9 | 37.0 | 24.1 | 24.6 | 14.9 | 15.0 | 10 | 10 | 5 | 5 | 90.9 | 91.6 |
| Douglass, . | - | - | - | - | - | - | - | - | - | - | 92.7 | 93.1 |

Fourth period : Herd I., standard ration ; Herd II., Cleveland flax meal ration.

| | | | | | | | | | | | | |
|-------------|------|------|------|------|------|------|----|----|---|---|------|------|
| Gude, . | 36.0 | 35.0 | 25.0 | 24.7 | 15.0 | 15.0 | 10 | 10 | 5 | 5 | 91.0 | 89.7 |
| Douglass, . | - | - | - | - | - | - | - | - | - | - | 91.6 | 90.1 |

Standard Score.

| | | | | | | | | | | | | |
|-------------|------|------|------|------|------|------|----|----|---|---|-------|-------|
| Gude, . | 45.0 | 45.0 | 25.0 | 25.0 | 15.0 | 15.0 | 10 | 10 | 5 | 5 | 100.0 | 100.0 |
| Douglass, . | 50.0 | 50.0 | 20.0 | 20.0 | 15.0 | 15.0 | 10 | 10 | 5 | 5 | 100.0 | 100.0 |

So far as the judgment of practical scorers is concerned, little difference was noted in the flavor and body of the butter made from the different rations. The butter made

from the cotton-seed meal and from the cotton-seed oil rations appears to have been a trifle more satisfactory, on the whole, than that made from the standard ration, and that made from the Cleveland flax meal ration a trifle less so. Judging from the remarks of Mr. Gude, the tendency of the standard ration and the cotton-seed meal ration was to produce a hard, crumbly butter, which the cotton-seed oil counteracted, causing it to become softer and more yielding in its nature.

The observation of the writer was that the butter produced by the cotton-seed meal ration was a little softer than that produced by the standard ration.

The butter produced by the cotton-seed oil ration was noticeably softer and more yielding than that produced by the standard ration. The difference was not sufficient to render the former butter objectionable, from a commercial stand-point. At a temperature of 80° F. the standard ration butter stood up well and could be handled, although somewhat soft; while the cotton-seed oil butter was handled with difficulty, appearing to have lost its consistency or body.

The butter produced by the flax meal ration was not noticeably different from that produced by the standard ration butter. Most of the cows during this period were in advanced stage of lactation, so that the results obtained are not particularly satisfactory.

TABLE VI. — *Average Degrees of Penetration (Millimeters).*

| FIRST PERIOD. | | SECOND PERIOD. | | THIRD PERIOD. | | FOURTH PERIOD. | |
|---------------|----------|----------------|----------|---------------|----------|----------------|----------|
| Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. | Herd I. | Herd II. |
| 4.7 | 4.6 | 4.5 | 4.4 | 4.4 | 5.0 | 5.2 | 5.4 |

By degrees of penetration is meant the number of millimeters a small glass plunger loaded with mercury will penetrate into butter when dropped from a definite height. No differences were noted excepting in the third period, when the plunger penetrated deeper into the butter produced by the cotton-seed oil, showing its more yielding character.

Results. — The following are the most important results :—

1. Cotton-seed meal with a minimum percentage of oil did not alter the percentage composition of the milk.

2. The addition of one-half to three-fourths of a pound of cotton-seed oil to the cotton-seed meal appeared to increase the fat percentage in the milk about four-tenths of one per cent. (5 to 5.4), and this increase was maintained during the six weeks of the feeding period.

3. The substitution of Cleveland flax meal for the cotton-seed meal and oil resulted in a decrease of the fat in the milk to about the percentage found in the first period, while the nitrogen percentage was increased. This change in composition was probably due to the removal of the cotton-seed oil from the ration, and not to the influence of the flax meal.

4. Cotton-seed meal with minimum oil caused no marked variation in the chemical composition of the butter fat.

5. The addition of cotton-seed oil to the cotton-seed meal ration produced a noticeable increase in the melting point and iodine number of butter fat.

6. Cotton-seed meal with a minimum oil produced a firm butter.

7. The addition of cotton-seed oil, while it increased the melting point of the butter fat, produced a softer, more yielding butter than that produced by either the cotton-seed meal or the standard ration.

8. An excess of cotton-seed oil in the ration is likely to affect the health of the animal.

B. NOTES ON SUMMER FORAGE CROPS.

J. B. LINDSEY.

This division has carried on experiments with green crops for a number of years, in order to ascertain those best suited to local conditions for summer forage. The results of these observations were published in Bulletin No. 72, issued in the spring of 1901. Observations with a number of crops have been continued the past season.

Wheat and Winter Vetch.—This is one of the earliest spring forage crops. It has been grown at this station for two consecutive years, with very satisfactory results. A full description of the crop and method of cultivation is found in the above bulletin. About one-third of an acre was seeded the first of the present September, and has made an excellent growth and promises well for the coming season. The experience obtained with this mixture leads to the conclusion that it is decidedly preferable to winter rye for early forage, although not ready to cut until a week later. The vetch thus far has proved perfectly able to withstand the winter. The digestibility of this mixture, both green and in the form of hay, has been made, but the results are not yet available for publication.

Corn and Cow Peas.—It has been the intention, so far as practicable, to grow mixtures of legumes and non-legumes, in order to increase the amount of protein in the several forage crops. For a number of years corn and medium green soy beans have been grown together quite successfully. The past season Longfellow corn and black cow-peas were sown together in rows three and one-half feet apart, with an Eclipse corn planter, at the rate of ten quarts of corn and seven quarts of peas to the acre. The soil was rather of a

light loam, and somewhat sensitive to drought. The rainfall proved sufficient, and the yield was heavy, being at the rate of twenty-three tons to the acre. The peas spread out, nearly covering the space between the rows, twining themselves at the same time about the stalks of corn. The crop was harvested with some difficulty, because of its tangled condition, but proved quite satisfactory for green fodder. This mixture, as well as that of corn and soy beans, will be grown again the coming season. It is believed that such fodder combination will enable the farmer to get along with less purchased grain.

Barnyard Millet. — Several plots of this fodder were grown and fed the past season. The results fully confirm the opinion concerning this crop expressed in last year's report. Its chief value is unquestionably for green forage. The first crop, sown about the middle of May, can be cut as early as July 15 to 20, and if successive seedings are made, green forage may be had until into September. Cutting should begin just before the heads appear, and the crop is at its best for eight to ten days thereafter. After it is headed it becomes tough, and animals refuse quite a portion of it. In order, therefore, to secure green fodder from such a source for a considerable period, it is necessary that small pieces of ground be seeded every ten days. This millet succeeds best upon warm, rather heavy, moist, fertile soils. Such conditions favor the production of sixteen to twenty tons to the acre, and even larger yields have been reported. Upon light soils the writer prefers corn, or corn and beans, for a soiling crop, after August 15. The millet when in blossom is probably as nutritious as corn fodder at the same stage of growth. Corn fodder, however, can be grown until more or less eared, and still be readily eaten, and in this condition the corn will naturally have a superior feeding value.

Barnyard millet is unsuited for hay, and is only to be preferred to corn for silage when for any reason it is not possible to secure a crop of corn.

PART III. — COMPILATION OF ANALYSES OF FODDER ARTICLES AND DAIRY PRODUCTS, MADE AT AMHERST, MASS., 1868–1901.

Prepared by E. B. HOLLAND and P. H. SMITH, JR.

A. COMPOSITION AND DIGESTIBILITY OF FODDER ARTICLES.

I. — Green fodders.

- (a) Meadow grasses and millets.
- (b) Cereals.
- (c) Legumes.
- (d) Mixed and miscellaneous.

II. — Silage.

III. — Hay and dry, coarse fodders.

- (a) Meadow grasses and millets.
- (b) Cereals.
- (c) Legumes.
- (d) Straw.
- (e) Mixed and miscellaneous.

IV. — Vegetables, fruits, etc.

V. — Concentrated feeds.

- (a) Protein.
- (b) Starchy.
- (c) Poultry.

B. FERTILIZER INGREDIENTS OF FODDER ARTICLES. (For classification, see A and C.)

C. ANALYSES OF DAIRY PRODUCTS.

A. COMPOSITION AND DIGESTIBILITY OF FODDER ARTICLES.
[Figures equal percentages or pounds in 100.]

| NAME. | Number of Analyses. | COMPOSITION. | | | | | | DIGESTIBILITY. | | | | | | | | | | | |
|--|---------------------|-----------------------------|------|----------|--------|------------------------|------|-----------------------|--------|------------------------|------|-----------------------------|--------|------------------------|------|-----------------------|------|------|------|
| | | FRESH OR AIR-DRY SUBSTANCE. | | | | | | WATER-FREE SUBSTANCE. | | | | FRESH OR AIR-DRY SUBSTANCE. | | | | WATER-FREE SUBSTANCE. | | | |
| | | Water. | Ash. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | | | | |
| I.—GREEN FODDERS. | | | | | | | | | | | | | | | | | | | |
| (a) Meadow Grasses and Millets. | | | | | | | | | | | | | | | | | | | |
| Johnson grass (<i>Andropogon halepensis</i>), | 1 | 75* | 1.4 | 1.2 | 8.9 | 13.2 | 0.3 | 4.6 | 35.7 | 53.0 | 1.2 | - | - | - | - | - | - | - | - |
| Orchard grass, | 7 | 70 | 2.1 | 2.9 | 10.4 | 13.7 | 0.9 | 9.7 | 34.8 | 45.6 | 3.0 | - | - | - | - | - | - | - | - |
| Tall oat grass, | 4 | 70 | 1.6 | 2.3 | 10.8 | 14.7 | 0.6 | 7.5 | 36.0 | 49.0 | 2.2 | - | - | - | - | - | - | - | - |
| Japanese millet (variety uncertain), . | 3 | 80 | 1.1 | 1.2 | 7.1 | 10.2 | 0.4 | 6.0 | 35.4 | 50.9 | 2.1 | - | - | - | - | - | - | - | - |
| Pearl millet (<i>Pennisetum spicatum</i>), . | 1 | 75 | 1.7 | 1.8 | 8.6 | 12.6 | 0.3 | 7.2 | 34.4 | 50.5 | 1.0 | - | - | - | - | - | - | - | - |
| Common millet (<i>Chenopodium italicum</i>), . | 16 | 75 | 1.2 | 1.9 | 8.1 | 13.2 | 0.6 | 7.4 | 32.4 | 52.7 | 2.5 | 1.2 | 5.8 | 9.0 | 0.4 | 4.7 | 23.0 | 35.8 | 1.7† |
| Canary bird seed millet (<i>Chenopodium italicum</i>). | 1 | 80 | 1.6 | 1.0 | 7.1 | 10.0 | 0.3 | 5.0 | 35.5 | 50.0 | 1.5 | - | - | - | - | - | - | - | - |
| Early harvest millet (<i>Chenopodium italicum</i>), | 1 | 80 | 1.4 | 1.1 | 7.4 | 9.7 | 0.4 | 5.5 | 37.0 | 48.5 | 2.0 | - | - | - | - | - | - | - | - |
| Golden millet (<i>Chenopodium italicum</i>), . | 1 | 75 | 1.5 | 1.0 | 8.7 | 13.4 | 0.4 | 4.0 | 34.8 | 53.4 | 1.6 | - | - | - | - | - | - | - | - |
| Hungarian grass (<i>Chenopodium italicum</i>), . | 3 | 75 | 1.8 | 2.4 | 7.2 | 13.1 | 0.5 | 9.8 | 28.6 | 52.3 | 2.0 | 1.5 | 5.1 | 8.9 | 0.3 | 6.3 | 20.3 | 35.6 | 1.3 |
| Japanese millet (<i>Chenopodium italicum</i>), . | 12 | 80 | 1.2 | 1.7 | 6.2 | 10.5 | 0.4 | 8.2 | 31.2 | 52.5 | 2.0 | 1.0 | 4.1 | 7.1 | 0.3 | 5.0 | 20.6 | 35.7 | 1.3† |
| Barnyard millet (<i>Panicum crus-galli</i>), . | 7 | 80 | 1.7 | 1.9 | 6.5 | 9.5 | 0.4 | 9.5 | 32.5 | 47.6 | 1.9 | 1.2 | 4.3 | 6.5 | 0.3 | 5.8 | 21.5 | 32.4 | 1.2 |

Fox-tail millets.

| | | | | | | | | | | | | | | | | | | | |
|--|---|----|-----|-----|-----|------|-----|------|------|------|-----|-----|-----|-----|-----|------|------|------|-----|
| Prussian blue pea (<i>Pisum arvense</i>), . . . | 1 | 80 | 1.8 | 3.7 | 6.0 | 7.8 | 0.7 | 18.7 | 30.0 | 39.1 | 3.4 | 3.0 | 3.7 | 5.5 | 0.4 | 15.3 | 18.6 | 27.8 | 1.8 |
| Flat pea (<i>Lathyrus sylvestris wagneri</i>), . . | 2 | 80 | 1.8 | 5.8 | 4.9 | 6.6 | 0.9 | 29.0 | 24.8 | 32.9 | 4.3 | - | - | - | - | - | - | - | - |
| Sainfoin (<i>Onobrychis sativa</i>), . . . | 1 | 75 | 2.1 | 4.4 | 6.0 | 11.6 | 0.9 | 17.4 | 24.0 | 46.5 | 3.5 | - | - | - | - | - | - | - | - |
| Serradella (<i>Ornithopus sativus</i>), . . . | 3 | 80 | 2.1 | 2.9 | 5.9 | 8.7 | 0.4 | 14.4 | 29.5 | 43.3 | 2.2 | - | - | - | - | - | - | - | - |
| Sulla (<i>Hedysarum coronarium</i>), . . . | 2 | 75 | 2.3 | 4.3 | 5.2 | 12.5 | 0.7 | 17.1 | 20.7 | 50.2 | 2.7 | - | - | - | - | - | - | - | - |
| Scotch tares (<i>Vicia sativa</i>), . . . | 1 | 80 | 2.4 | 3.9 | 5.7 | 7.7 | 0.3 | 19.5 | 28.3 | 38.3 | 1.7 | - | - | - | - | - | - | - | - |
| Spring vetch (<i>Vicia sativa</i>), . . . | 3 | 80 | 1.7 | 3.5 | 6.0 | 8.3 | 0.5 | 17.4 | 30.2 | 41.6 | 2.4 | 2.5 | 2.6 | 6.3 | 0.3 | 12.3 | 13.3 | 31.6 | 1.4 |
| Hairy or sand vetch (<i>Vicia villosa</i>), . . | 1 | 80 | 1.7 | 4.0 | 6.3 | 7.8 | 0.2 | 20.0 | 31.6 | 38.9 | 1.1 | 3.3 | 3.8 | 5.9 | 0.1 | 16.6 | 19.3 | 29.6 | 0.8 |
| Kidney vetch (<i>Anthyllis vulneraria</i>), . . | 1 | 80 | 2.7 | 3.7 | 3.1 | 9.8 | 0.7 | 18.4 | 15.3 | 48.9 | 3.7 | - | - | - | - | - | - | - | - |
| (d) Mixed and Miscellaneous. | | | | | | | | | | | | | | | | | | | |
| Barley and peas, . . . | 1 | 80 | 1.6 | 2.8 | 6.8 | 8.2 | 0.6 | 13.8 | 33.8 | 41.2 | 3.1 | 2.2 | 2.9 | 5.0 | 0.4 | 10.6 | 14.5 | 25.1 | 1.9 |
| Barley and vetch, . . . | 2 | 80 | 1.2 | 2.8 | 6.5 | 9.0 | 0.5 | 13.8 | 32.4 | 45.2 | 2.3 | - | - | - | - | - | - | - | - |
| Corn and soy bean, . . . | 1 | 80 | 1.3 | 2.7 | 4.3 | 11.2 | 0.5 | 13.8 | 21.3 | 56.1 | 2.4 | - | - | - | - | - | - | - | - |
| Millet and peas, . . . | 1 | 80 | 1.8 | 2.4 | 7.5 | 8.0 | 0.3 | 12.0 | 37.5 | 39.9 | 1.5 | - | - | - | - | - | - | - | - |
| Tall oat grass and alsike clover, . . . | 2 | 80 | 1.5 | 2.7 | 5.8 | 9.5 | 0.5 | 13.6 | 28.8 | 47.2 | 2.7 | - | - | - | - | - | - | - | - |
| Orchard grass and alsike clover, . . . | 1 | 80 | 1.5 | 2.4 | 6.5 | 9.0 | 0.7 | 11.9 | 32.5 | 45.1 | 2.8 | - | - | - | - | - | - | - | - |
| Peas and oats, . . . | 4 | 80 | 1.7 | 2.9 | 6.0 | 8.8 | 0.6 | 14.4 | 30.0 | 44.1 | 3.0 | 2.0 | 4.0 | 6.7 | 0.3 | 10.1 | 20.4 | 33.5 | 1.7 |
| Vetch and oats (1-1), . . . | 3 | 80 | 1.8 | 3.0 | 6.3 | 8.4 | 0.5 | 15.1 | 31.4 | 42.1 | 2.7 | 2.3 | 4.3 | 5.7 | 0.2 | 11.3 | 21.4 | 28.6 | 1.3 |
| Vetch and oats (1-4), . . . | 1 | 80 | 1.8 | 2.7 | 6.0 | 8.8 | 0.7 | 13.3 | 30.0 | 43.8 | 3.8 | - | - | - | - | - | - | - | - |
| Wheat and vetch, . . . | 2 | 80 | 1.5 | 3.2 | 6.5 | 8.2 | 0.5 | 16.2 | 32.6 | 41.2 | 2.5 | - | - | - | - | - | - | - | - |
| Apple pomace, . . . | 3 | 83 | 0.4 | 1.2 | 2.9 | 11.7 | 0.8 | 7.1 | 17.0 | 68.8 | 4.7 | - | - | - | - | - | - | - | - |

* Same coefficients applied to all Canada peas.

II.—SILAGE.

| | | | | | | | | | | | | | | | | | | | |
|---|----|----|-----|------|------|------|-----|------|------|------|-----|-----|------|------|-----|-----|------|------|-----|
| Apple pomace, | 1 | 85 | 0.6 | 1.2 | 3.3 | 8.8 | 1.1 | 8.0 | 22.0 | 58.7 | 7.3 | - | - | - | - | - | - | - | - |
| Corn, | 45 | 80 | 1.1 | 1.7 | 5.4 | 11.1 | 0.7 | 8.5 | 26.8 | 55.7 | 3.5 | 1.0 | 3.8 | 8.4 | 0.6 | 4.8 | 18.8 | 42.3 | 2.9 |
| Corn and soy bean, | 4 | 76 | 2.4 | 2.5 | 7.2 | 11.1 | 0.8 | 10.4 | 30.0 | 46.3 | 3.3 | 1.6 | 4.7 | 8.3 | 0.7 | 6.8 | 19.5 | 34.7 | 2.7 |
| Millet, | 3 | 74 | 2.4 | 1.7 | 7.5 | 13.6 | 0.8 | 6.5 | 28.8 | 52.3 | 3.1 | - | - | - | - | - | - | - | - |
| Millet and soy bean, | 9 | 79 | 2.8 | 2.8 | 7.2 | 7.2 | 1.0 | 13.3 | 34.3 | 34.3 | 4.8 | 1.6 | 5.0 | 4.3 | 0.7 | 7.7 | 23.7 | 20.2 | 3.5 |
| III.—HAY AND DRY COARSE FODDERS. | | | | | | | | | | | | | | | | | | | |
| (a) <i>Meadow Grasses and Millets.</i> | | | | | | | | | | | | | | | | | | | |
| Barneyard grass (<i>Panicum crus-galli</i>), | 1 | 14 | 8.6 | 13.1 | 29.0 | 33.6 | 1.7 | 15.2 | 33.7 | 39.1 | 2.0 | - | - | - | - | - | - | - | - |
| Barneyard millet (<i>Panicum crus-galli</i>), | 7 | 14 | 7.3 | 8.2 | 28.0 | 40.9 | 1.6 | 9.5 | 32.5 | 47.6 | 1.9 | 5.3 | 17.4 | 21.3 | 0.7 | 6.1 | 20.2 | 24.8 | 0.9 |
| Canada blue grass (<i>Poa compressa</i>), | 1 | 14 | 4.8 | 5.9 | 31.3 | 42.1 | 0.9 | 6.9 | 36.4 | 48.9 | 2.2 | - | - | - | - | - | - | - | - |
| Hungarian grass (<i>Chetochloa italica</i>), | 3 | 14 | 6.3 | 8.4 | 24.6 | 45.0 | 1.7 | 9.8 | 28.6 | 52.3 | 2.0 | 5.0 | 16.7 | 30.2 | 1.1 | 5.9 | 19.4 | 35.0 | 1.3 |
| Italian rye grass (<i>Lolium italicum</i>), | 4 | 14 | 6.4 | 7.1 | 28.6 | 42.2 | 1.6 | 8.4 | 33.2 | 49.0 | 1.9 | - | - | - | - | - | - | - | - |
| Kentucky blue grass (<i>Poa pratensis</i>), | 3 | 14 | 6.4 | 7.7 | 30.5 | 39.7 | 1.7 | 8.9 | 35.5 | 46.1 | 2.0 | 4.4 | 19.2 | 21.0 | 0.7 | 5.1 | 22.4 | 24.4 | 0.9 |
| Meadow fescue (<i>Festuca elatior pratensis</i>), | 7 | 14 | 7.1 | 5.8 | 32.2 | 39.3 | 1.6 | 6.8 | 37.4 | 45.6 | 1.9 | 3.0 | 21.6 | 23.2 | 0.9 | 3.5 | 25.1 | 26.9 | 1.0 |
| Orchard grass (<i>Dactylis glomerata</i>), | 7 | 14 | 5.9 | 8.3 | 29.9 | 39.3 | 2.6 | 9.7 | 34.8 | 45.6 | 3.0 | 4.9 | 17.9 | 21.6 | 1.4 | 5.7 | 20.9 | 25.1 | 1.6 |
| Perennial rye grass (<i>Lolium perenne</i>), | 4 | 14 | 7.9 | 10.1 | 25.4 | 40.5 | 2.1 | 11.8 | 29.5 | 47.1 | 2.4 | - | - | - | - | - | - | - | - |
| Red top (<i>Agrostis alba vulgaris</i>), | 6 | 14 | 4.6 | 6.5 | 28.5 | 44.9 | 1.5 | 7.6 | 33.2 | 52.2 | 1.7 | 4.0 | 17.4 | 27.8 | 0.8 | 4.6 | 20.3 | 32.4 | 0.9 |
| Red top (early cut), | 1 | 14 | 4.3 | 5.8 | 30.9 | 43.3 | 1.7 | 6.8 | 35.9 | 50.3 | 2.0 | 3.5 | 18.9 | 26.9 | 0.9 | 4.1 | 21.9 | 31.2 | 1.0 |
| Red top (late cut), | 1 | 14 | 4.1 | 6.0 | 31.0 | 43.2 | 1.7 | 7.0 | 36.0 | 50.2 | 2.0 | 3.7 | 18.9 | 26.8 | 0.9 | 4.3 | 21.9 | 31.1 | 1.0 |
| Tall oat grass (<i>Arrhenatherum elatius</i>), | 4 | 14 | 4.6 | 6.4 | 30.9 | 42.1 | 1.9 | 7.4 | 36.0 | 49.0 | 2.2 | 3.3 | 17.0 | 24.4 | 1.1 | 3.8 | 19.8 | 28.4 | 1.2 |

* Same coefficients applied to all varieties of rape.

| | | | | | | | | | | | | | | | | | | | |
|--|----|----|-----|------|------|------|-----|------|------|------|-----|-----|------|------|-----|------|------|------|-----|
| High grown salt hay (largely <i>Spartina patens</i>). | 1 | 16 | 7.0 | 6.3 | 22.2 | 46.4 | 2.1 | 7.5 | 26.4 | 55.3 | 2.5 | 3.8 | 11.8 | 24.6 | 0.8 | 4.5 | 13.9 | 29.3 | 0.9 |
| Fox grass (<i>Spartina patens</i>), | 2 | 16 | 5.8 | 6.7 | 22.5 | 46.9 | 2.1 | 8.0 | 26.8 | 55.8 | 2.5 | 4.0 | 11.9 | 24.9 | 0.8 | 4.8 | 14.2 | 29.6 | 0.9 |
| Cove mixture (black grass and red top), . | 1 | 16 | 6.0 | 7.4 | 23.2 | 45.6 | 1.8 | 8.8 | 27.6 | 54.3 | 2.1 | 3.6 | 13.9 | 24.2 | 0.7 | 4.2 | 16.6 | 28.8 | 0.8 |
| Mixed salt hay (largely fox grass and branch grass). | 1 | 16 | 8.4 | 5.5 | 22.5 | 45.5 | 2.1 | 6.5 | 26.8 | 54.2 | 2.5 | 2.3 | 13.1 | 23.7 | 0.6 | 2.7 | 15.5 | 28.2 | 0.7 |
| Salt hay (variety uncertain), | 2 | 16 | 4.3 | 3.4 | 24.0 | 49.8 | 2.5 | 4.0 | 28.6 | 59.3 | 3.0 | 1.4 | 13.9 | 25.9 | 0.7 | 1.7 | 16.6 | 30.8 | 0.8 |
| (b) Cereal Folders. | | | | | | | | | | | | | | | | | | | |
| Corn stover, from field, | 41 | 40 | 3.9 | 4.6 | 20.6 | 30.1 | 0.8 | 7.6 | 24.2 | 50.2 | 1.4 | 1.7 | 13.2 | 17.5 | 0.5 | 2.7 | 21.9 | 29.1 | 1.0 |
| Corn stover, very dry, | 41 | 20 | 5.2 | 6.1 | 27.4 | 40.2 | 1.1 | 7.6 | 34.2 | 50.2 | 1.4 | 2.2 | 17.5 | 23.3 | 0.8 | 2.7 | 21.9 | 29.1 | 1.0 |
| Oats, | 6 | 15 | 6.9 | 11.7 | 25.5 | 38.3 | 2.6 | 13.8 | 30.0 | 45.0 | 3.1 | 6.8 | 12.8 | 13.4 | 1.6 | 8.0 | 15.0 | 15.8 | 2.0 |
| (c) Legumes. | | | | | | | | | | | | | | | | | | | |
| Alsike clover, | 8 | 15 | 9.7 | 14.0 | 23.1 | 36.1 | 2.1 | 16.5 | 27.2 | 42.4 | 2.5 | 9.2 | 12.2 | 25.6 | 1.1 | 10.9 | 14.4 | 30.1 | 1.3 |
| Mammoth red clover, | 4 | 15 | 8.2 | 13.1 | 24.4 | 37.6 | 1.7 | 15.4 | 28.7 | 44.2 | 2.1 | - | - | - | - | - | - | - | - |
| Medium red clover, | 5 | 15 | 7.4 | 11.8 | 26.0 | 37.5 | 2.3 | 13.9 | 30.6 | 44.1 | 2.7 | 6.8 | 14.0 | 24.0 | 1.3 | 8.1 | 16.5 | 28.2 | 1.5 |
| (d) Straw. | | | | | | | | | | | | | | | | | | | |
| Barley, | 2 | 15 | 4.8 | 6.5 | 32.2 | 39.0 | 2.5 | 7.7 | 37.9 | 45.9 | 2.9 | - | - | - | - | - | - | - | - |
| Horse bean, | 1 | 15 | 8.1 | 8.3 | 35.2 | 32.1 | 1.3 | 9.8 | 41.4 | 37.8 | 1.5 | - | - | - | - | - | - | - | - |
| Soy bean, | 3 | 15 | 6.1 | 4.7 | 36.1 | 36.3 | 1.8 | 5.5 | 42.5 | 42.7 | 2.1 | - | - | - | - | - | - | - | - |
| Millet (<i>Chenopodium italicum</i>), | 1 | 15 | 5.3 | 3.6 | 35.2 | 39.5 | 1.4 | 4.2 | 41.4 | 46.5 | 1.7 | - | - | - | - | - | - | - | - |
| Millet (<i>Panicum crus-galli</i>), | 1 | 15 | 4.6 | 5.2 | 30.4 | 42.7 | 2.1 | 6.1 | 35.8 | 50.2 | 2.5 | - | - | - | - | - | - | - | - |
| Millet (<i>Panicum miliaceum</i>), | 1 | 15 | 5.2 | 3.3 | 35.9 | 38.1 | 2.5 | 3.9 | 42.2 | 44.8 | 3.0 | - | - | - | - | - | - | - | - |
| Millet (variety uncertain), | 1 | 15 | 5.8 | 4.2 | 35.5 | 38.3 | 1.2 | 4.9 | 41.8 | 45.1 | 1.4 | - | - | - | - | - | - | - | - |
| Wheat, | 1 | 15 | 4.1 | 6.2 | 30.5 | 42.8 | 1.4 | 7.3 | 35.9 | 50.4 | 1.6 | - | - | - | - | - | - | - | - |

A. Composition and Digestibility of Fodder Articles — Continued.

| NAME. | Number of Analyses. | COMPOSITION. | | | | | | DIGESTIBILITY. | | | | | | | |
|--|---------------------|-----------------------------|------|----------|--------|------------------------|------|-----------------------------|--------|------------------------|------|--|--|-----|-----|
| | | FRESH OR AIR-DRY SUBSTANCE. | | | | | | FRESH OR AIR-DRY SUBSTANCE. | | | | | | | |
| | | WATER-FREE SUBSTANCE. | | | | | | WATER-FREE SUBSTANCE. | | | | | | | |
| | | Water. | Ash. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | | | | |
| III.—HAY AND DRY COARSE FODDERS —Con. | | | | | | | | | | | | | | | |
| (c) Mixed and Miscellaneous. | | | | | | | | | | | | | | | |
| Oat grass and alsike clover, | 2 | 15 | 6.5 | 11.6 | 24.5 | 40.1 | 2.3 | 13.6 | 28.8 | 47.2 | 2.7 | | | | |
| Orchard grass and alsike clover, | 1 | 15 | 6.6 | 10.1 | 27.6 | 38.3 | 2.4 | 11.9 | 32.5 | 45.1 | 2.8 | | | | |
| Peas and oats, | 4 | 15 | 7.2 | 12.2 | 25.5 | 37.5 | 2.6 | 14.4 | 30.0 | 44.1 | 3.0 | | | | |
| Vetch and oats (1-1), | 3 | 15 | 7.4 | 12.8 | 26.7 | 35.8 | 2.3 | 15.1 | 31.4 | 42.1 | 2.7 | | | 8.6 | 0.6 |
| Wheat and vetch, | 2 | 15 | 6.4 | 13.8 | 27.7 | 35.0 | 2.1 | 16.2 | 32.6 | 41.2 | 2.5 | | | 9.1 | 0.5 |
| White daisy, | 1 | 15 | 6.0 | 6.6 | 30.7 | 39.7 | 2.0 | 7.8 | 36.1 | 46.7 | 2.4 | | | | |
| Hairy lotus, | 2 | 15 | 7.0 | 12.6 | 16.8 | 46.1 | 2.5 | 14.8 | 19.8 | 54.2 | 3.0 | | | | |
| IV.—VEGETABLES, FRUITS, ETC. | | | | | | | | | | | | | | | |
| Apples, | 2 | 78 | 0.7 | 1.0 | 1.5 | 18.3 | 0.5 | 4.5 | 6.8 | 83.2 | 2.3 | | | | |
| Artichokes, | 1 | 78 | 1.1 | 2.9 | 0.9 | 16.9 | 0.2 | 13.1 | 4.1 | 76.9 | 0.9 | | | | |
| Cabbages, | 1 | 90 | 0.8 | 2.6 | 0.9 | 5.5 | 0.2 | 25.7 | 9.3 | 54.8 | 2.3 | | | | |
| Beets, red, | 7 | 88 | 1.1 | 1.5 | 0.7 | 8.6 | 0.1 | 12.5 | 5.8 | 71.7 | 0.8 | | | | |

| | 13 | 86 | 0.9 | 1.6 | 0.9 | 10.5 | 0.1 | 11.0 | 6.7 | 75.1 | 0.7 | 1.5 | 0.9 | 10.5 | 0.05 | 10.0 | 6.7 | 75.1 | 0.4 |
|---|-----|-----|-----|------|------|-------|------|------|------|-------|------|------|-----|------|------|------|------|------|------|
| Sugar beets, | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Yellow fodder beets, | 4 | 89 | 1.0 | 1.3 | 1.0 | 7.5 | 0.2 | 11.8 | 9.1 | 68.2 | 1.8 | 1.0 | - | 4.2 | - | 9.1 | - | 65.5 | - |
| Mangolds, | 5 | 88 | 1.2 | 1.4 | 0.8 | 8.5 | 0.1 | 11.7 | 6.7 | 70.8 | 0.8 | 1.0 | 0.3 | 7.7 | - | 8.8 | 2.9 | 64.4 | - |
| Carrots, | 5 | 89 | 0.9 | 1.0 | 1.1 | 7.8 | 0.2 | 9.1 | 10.0 | 70.9 | 1.8 | - | - | - | - | - | - | - | - |
| Cranberries, | 1 | 89 | 0.2 | 0.5 | 1.2 | 8.5 | 0.6 | 4.5 | 10.9 | 77.3 | 5.5 | - | - | - | - | - | - | - | - |
| Parsnips, | 1 | 90 | 1.5 | 1.3 | 1.5 | 15.0 | 0.7 | 6.5 | 7.5 | 75.0 | 3.5 | - | - | - | - | - | - | - | - |
| Potatoes, | 22 | 80 | 0.9 | 2.1 | 0.5 | 16.4 | 0.1 | 10.2 | 2.6 | 82.0 | 0.5 | 1.0 | - | 14.8 | - | 4.6 | - | 7.3 | .07 |
| Potatoes, | 93 | 80 | - | - | - | 14.3* | - | - | - | 71.5* | - | - | - | - | - | - | - | - | - |
| Japanese radish, | 1 | 93 | 0.7 | 0.5 | 0.7 | 5.0 | 0.1 | 7.1 | 10.0 | 71.5 | 1.4 | - | - | - | - | - | - | - | - |
| Turnips, | 5 | 90 | 0.9 | 1.5 | 1.2 | 6.6 | 0.2 | 11.0 | 12.0 | 66.0 | 2.0 | 1.4 | 1.2 | 6.3 | 0.2 | 9.9 | 12.0 | 63.4 | 1.7 |
| Ruta-bagas, | 3 | 89 | 1.1 | 1.2 | 1.3 | 7.2 | 0.2 | 10.9 | 11.8 | 65.5 | 1.8 | 1.0 | 1.0 | 6.8 | 0.2 | 8.7 | 8.7 | 62.2 | 1.5 |
| V. — CONCENTRATED FEEDS. | | | | | | | | | | | | | | | | | | | |
| (a) Protein. | | | | | | | | | | | | | | | | | | | |
| Cotton-seed meal, | 129 | 7.0 | 6.5 | 45.1 | 6.1 | 24.2 | 11.1 | 48.5 | 6.6 | 26.0 | 11.9 | 39.7 | 3.4 | 14.8 | 9.4 | 42.7 | 3.6 | 15.9 | 11.1 |
| Cotton-seed meal (low grade), | 31 | 8.0 | 4.7 | 27.1 | 17.6 | 35.2 | 7.4 | 29.5 | 19.1 | 38.3 | 8.0 | - | - | - | - | - | - | - | - |
| Cleveland flax meal, | 19 | 9.0 | 5.3 | 38.3 | 8.8 | 36.2 | 2.4 | 42.1 | 9.7 | 39.8 | 2.6 | 32.4 | 7.0 | 31.1 | 2.3 | 35.8 | 7.8 | 34.2 | 2.5 |
| Linseed meal (new process), | 8 | 9.0 | 5.8 | 35.8 | 8.5 | 38.0 | 2.9 | 39.3 | 9.3 | 41.8 | 3.2 | 30.4 | 6.8 | 32.7 | 2.8 | 33.4 | 7.4 | 36.0 | 3.1 |
| Linseed meal (old process), | 55 | 8.5 | 5.2 | 35.3 | 8.5 | 36.5 | 6.0 | 38.6 | 9.2 | 39.9 | 6.6 | 31.4 | 4.9 | 28.5 | 5.3 | 34.4 | 5.2 | 31.1 | 5.9 |
| Chicago gluten meal, | 49 | 9.5 | 1.0 | 37.2 | 2.2 | 47.9 | 2.2 | 41.1 | 2.4 | 52.9 | 2.5 | 32.7 | - | 43.1 | 2.1 | 36.2 | - | 47.6 | 2.4 |
| Cream gluten meal, | 50 | 9.0 | 0.9 | 34.3 | 2.2 | 51.6 | 2.0 | 37.7 | 2.4 | 56.7 | 2.2 | 30.2 | - | 46.4 | 1.9 | 33.2 | - | 51.0 | 2.1 |
| King gluten meal (new process), | 3 | 9.0 | -† | 32.0 | -† | -† | 2.9 | 35.2 | - | - | 3.2 | 28.2 | - | - | 2.7 | 31.0 | - | - | 3.0 |

† Not determined.

* Starch by Inversion.

| | 9 | 8.0 | 1.7 | 31.4 | 10.9 | 35.5 | 12.5 | 34.1 | 11.9 | 38.6 | 13.6 | 23.2 | - | 29.1 | 11.8 | 25.2 | - | 31.7 | 12.8 |
|--|-----|------|-----|------|------|------|------|------|------|------|------|------|-----|------|------|------|-----|------|------|
| Atlas gluten meal, | . | 8.0 | 1.7 | 31.4 | 10.9 | 35.5 | 12.5 | 34.1 | 11.9 | 38.6 | 13.6 | 23.2 | - | 29.1 | 11.8 | 25.2 | - | 31.7 | 12.8 |
| Malt sprouts, | 2 | 11.0 | 5.2 | 24.6 | 13.0 | 43.6 | 2.6 | 27.6 | 14.6 | 49.0 | 3.0 | 19.7 | 4.3 | 29.7 | 2.6 | 22.1 | 4.8 | 33.3 | 3.0 |
| Wheat middlings (fine and flour), | 50 | 10.0 | 3.2 | 18.8 | 3.2 | 60.1 | 4.7 | 20.9 | 3.6 | 66.7 | 5.2 | 16.0 | 1.2 | 52.9 | 4.0 | 17.8 | 1.3 | 58.7 | 4.4 |
| Wheat middlings (coarse, so-called stand- ard), | 177 | 10.0 | 4.3 | 17.8 | 7.0 | 55.8 | 5.1 | 19.8 | 7.8 | 61.9 | 5.7 | 14.2 | 2.3 | 45.2 | 4.4 | 15.8 | 2.6 | 50.1 | 4.9 |
| Mixed feed, | 368 | 10.0 | 5.4 | 16.8 | 8.6 | 54.5 | 4.7 | 18.7 | 9.5 | 60.6 | 5.2 | - | - | - | - | - | - | - | - |
| Mixed feed (low grade), | 6 | 9.0 | 4.3 | 12.1 | 16.1 | 55.4 | 3.1 | 13.3 | 17.7 | 60.9 | 3.4 | - | - | - | - | - | - | - | - |
| Wheat bran, | 209 | 10.0 | 6.4 | 16.0 | 10.0 | 53.0 | 4.6 | 17.8 | 11.1 | 58.9 | 5.1 | 12.5 | 2.9 | 36.6 | 3.1 | 13.9 | 3.2 | 40.6 | 3.5 |
| Wheat bran (spring), | 4 | 10.0 | 5.8 | 16.1 | 10.5 | 52.6 | 5.0 | 17.9 | 11.7 | 58.4 | 5.6 | - | - | - | - | - | - | - | - |
| Wheat bran (winter), | 3 | 10.0 | 6.2 | 15.3 | 8.6 | 57.0 | 2.9 | 17.0 | 9.6 | 63.3 | 3.2 | - | - | - | - | - | - | - | - |
| H-O dairy feed, | 10 | 8.0 | 3.6 | 18.0 | 13.0 | 53.3 | 4.1 | 19.6 | 14.1 | 57.9 | 4.5 | 14.0 | 5.3 | 37.3 | 3.5 | 15.3 | 5.8 | 40.5 | 3.8 |
| Buckwheat feed, | 1 | 9.0 | 5.0 | 32.3 | 7.5 | 37.7 | 8.5 | 35.5 | 8.2 | 41.4 | 9.4 | - | - | - | - | - | - | - | - |
| Buckwheat middlings, | 1 | 11.0 | 4.8 | 22.7 | 4.6 | 50.2 | 6.7 | 25.5 | 5.2 | 56.4 | 7.5 | - | - | - | - | - | - | - | - |
| Cocoanut meal, | 2 | 8.0 | 3.7 | 20.0 | 12.0 | 39.4 | 16.3 | 22.4 | 13.1 | 42.8 | 17.7 | - | - | - | - | - | - | - | - |
| Gluten flour, | 1 | 9.0 | 0.7 | 38.4 | 0.2 | 50.8 | 0.9 | 42.2 | 0.2 | 55.8 | 1.0 | - | - | - | - | - | - | - | - |
| Atlantic gluten meal, | 1 | 7.0 | 1.2 | 41.1 | 1.5 | 46.9 | 2.3 | 44.2 | 1.6 | 50.4 | 2.5 | - | - | - | - | - | - | - | - |
| Proteina, | 4 | 8.0 | 2.5 | 21.8 | 10.0 | 51.1 | 6.6 | 23.7 | 10.9 | 55.5 | 7.2 | - | - | - | - | - | - | - | - |
| Sucrene dairy feed, | 6 | 9.0 | 6.6 | 16.8 | 11.7 | 52.8 | 3.1 | 18.4 | 12.9 | 58.0 | 3.4 | - | - | - | - | - | - | - | - |
| Sucrene oil meal, | 3 | 9.0 | 5.7 | 23.2 | 10.7 | 48.6 | 2.8 | 25.5 | 11.7 | 53.4 | 3.1 | - | - | - | - | - | - | - | - |
| Horse beans, | 1 | 14.0 | 3.8 | 25.8 | 7.0 | 48.6 | 0.8 | 30.0 | 8.1 | 56.5 | 1.0 | - | - | - | - | - | - | - | - |
| Red adzuki beans, | 2 | 14.0 | 3.6 | 21.0 | 4.0 | 56.7 | 0.7 | 24.4 | 4.7 | 65.9 | 0.8 | - | - | - | - | - | - | - | - |
| Saddle beans, | 1 | 14.0 | 5.3 | 13.0 | 4.1 | 49.4 | 14.2 | 15.1 | 4.8 | 57.4 | 16.5 | - | - | - | - | - | - | - | - |

[†] See thirteenth report, p. 44.

*** Not determined.**

A. Composition and Digestibility of Fodder Articles — Concluded.

| NAME. | Number of Analyses. | COMPOSITION. | | | | | | | DIGESTIBILITY. | | | | | | | | | | |
|-----------------------------|---------------------|-----------------------------|------|----------|--------|------------------------|-----------------------|----------|-----------------------------|------------------------|-----------------------|----------|--------|------------------------|------|------|------|------|-----|
| | | FRESH OR AIR-DRY SUBSTANCE. | | | | | WATER-FREE SUBSTANCE. | | FRESH OR AIR-DRY SUBSTANCE. | | WATER-FREE SUBSTANCE. | | | | | | | | |
| | | Water. | Ash. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | Protein. | Fibre. | Nitrogen-free Extract. | Fat. | | | | |
| | | | | | | | | | | | | | | | | | | | |
| V.—CONCENTRATED FEEDS—Con. | | | | | | | | | | | | | | | | | | | |
| (b) Starchy—Con. | | | | | | | | | | | | | | | | | | | |
| Cotton-seed feed, | 4 | 11.0 | 3.1 | 10.5 | 36.0 | 35.9 | 3.5 | 11.8 | 40.5 | 40.3 | 3.9 | 5.4 | 16.6 | 19.8 | 3.0 | 6.0 | 18.6 | 22.2 | 3.4 |
| Flax-seed screenings, | 1 | 7.0 | 5.4 | 15.7 | 16.5 | 44.5 | 10.9 | 16.9 | 17.8 | 47.8 | 11.7 | - | - | - | - | - | - | - | - |
| Hominy meal, | 28 | 9.0 | 2.6 | 11.2 | 4.4 | 64.5 | 8.3 | 12.3 | 4.8 | 70.9 | 9.1 | - | - | - | - | - | - | - | - |
| H-O horse feed, | 12 | 9.0 | 3.1 | 12.6 | 9.8 | 62.0 | 3.5 | 13.8 | 10.8 | 68.1 | 3.9 | 9.3 | 3.4 | 49.0 | 2.9 | 10.2 | 3.8 | 53.8 | 3.0 |
| Maizeline, | 1 | 5.0 | 2.7 | 10.0 | 7.9 | 66.0 | 8.4 | 10.5 | 8.3 | 69.5 | 8.9 | - | - | - | - | - | - | - | - |
| Mellin's Food refuse, | 1 | 7.0 | 3.9 | 11.4 | 7.1 | 67.2 | 3.4 | 12.3 | 7.6 | 72.2 | 3.7 | - | - | - | - | - | - | - | - |
| Canada oat feed, | 2 | 7.0 | 5.4 | 13.2 | 24.8 | 44.7 | 4.9 | 14.2 | 26.7 | 48.1 | 5.3 | - | - | - | - | - | - | - | - |
| Oat feed (average quality), | 86 | 7.0 | 5.2 | 8.2 | 20.9 | 55.7 | 3.0 | 8.8 | 22.5 | 59.9 | 3.2 | 6.6 | 9.0 | 37.3 | 2.7 | 7.1 | 9.7 | 40.1 | 2.8 |
| Oat feed (low grade), | 2 | 7.0 | 4.6 | 2.7 | 30.2 | 54.4 | 1.0 | 2.9 | 32.5 | 58.5 | 1.1 | 1.7 | 9.7 | 18.0 | 0.9 | 1.8 | 10.4 | 19.3 | 1.0 |
| Oat meal, | 1 | 9.0 | 1.9 | 16.8 | 1.1 | 64.5 | 6.7 | 18.4 | 1.2 | 70.9 | 7.4 | - | - | - | - | - | - | - | - |
| Oat middlings, | 1 | 11.0 | 4.2 | 10.8 | 17.4 | 53.3 | 3.3 | 12.1 | 19.5 | 59.9 | 3.7 | - | - | - | - | - | - | - | - |
| Parson's "Six-dollar" feed, | 1 | 11.0 | 7.9 | 10.0 | 17.9 | 51.1 | 2.1 | 11.2 | 20.1 | 57.4 | 2.4 | - | - | - | - | - | - | - | - |

B. FERTILIZER INGREDIENTS OF FODDER ARTICLES.*

[Figures equal percentages or pounds in 100.]

| | Number of Analyses. | Water. | Nitrogen. | Potash. | Phosphoric Acid. |
|--|------------------------|--------|-----------|---------|---------------------|
| I.—GREEN FODDERS. | | | | | |
| <i>(a) Meadow Grasses and Millets.</i> | | | | | |
| Hungarian grass, | 1 | 75 | 0.38 | 0.52 | 0.15 |
| Japanese millet, | 3 | 80 | 0.33 | 0.22 | 0.10 |
| Barnyard millet, | 3 | 80 | 0.30 | 0.67 | 0.10 |
| Millet, | 1 | 80 | 0.29 | 0.43 | 0.11 |
| Orchard grass, | 4 | 70 | 0.43 | 0.56 | 0.13 |
| <i>(b) Cereal Fodders.</i> | | | | | |
| Corn fodder, | 21 | 80 | 0.39† | 0.27 | 0.13 |
| Oats, | 3 | 75 | 0.72 | 0.56 | 0.19 |
| Rye, | 2 | 75 | 0.27 | 0.57 | 0.11 |
| <i>(c) Legumes.</i> | | | | | |
| Alfalfa, | 4 | 75 | 0.55 | 0.39 | 0.14 |
| Horse bean, | 1 | 85 | 0.41 | 0.21 | 0.05 |
| Soy bean, | 1 | 75 | — | 0.49 | 0.14 |
| Soy bean (early white), | 1 | 75 | 0.71 | 0.69 | 0.16 |
| Soy bean (medium green), | 1 | 75 | 0.70 | 0.59 | 0.17 |
| Soy bean (medium black), | 1 | 75 | 0.88 | 0.62 | 0.20 |
| Soy bean (late), | 1 | 75 | 0.75 | 0.85 | 0.18 |
| Alsike clover, | 6 | 75 | 0.66 | 0.62 | 0.19 |
| Mammoth red clover, | 3 | 75 | 0.63 | 0.34† | 0.15 |
| Medium red clover, | 2 | 75 | 0.59 | 0.62 | 0.12 |
| Sweet clover, | 1 | 75 | 0.54 | 0.50 | 0.15 |
| White lupine, | 1 | 85 | 0.45 | 0.26 | 0.05 |
| Yellow lupine, | 1 | 85 | 0.40 | 0.44 | 0.09 |
| Cow-pea, | 1 | 80 | 0.36 | 0.20 | 0.11 |
| Flat pea, | 1 | 80 | 1.00 | 0.43 | 0.13 |
| Small pea, | 1 | 80 | 0.53 | 0.41 | 0.12 |
| Sainfoin, | 1 | 75 | 0.68 | 0.57 | 0.20 |
| Serradella, | 2 | 80 | 0.48 | 0.49 | 0.16 |

* Most of these analyses were made in earlier years by the Massachusetts State Experiment Station. The percentages of the several ingredients will vary considerably, depending upon the fertility of the soil, and especially upon the stage of growth of the plant. In the majority of cases the number of samples analyzed is too few to give a fair average. The figures, therefore, must be regarded as close approximations, rather than as representing absolutely the exact fertilizing ingredients of the different materials. (J. B. L.)

† Too high; 0.26 nearer correct.

‡ Evidently below normal.

B. Fertilizer Ingredients of Fodder Articles — Continued.

| | Number of Analyses. | Water. | Nitrogen. | Potash. | Phosphoric Acid. |
|---|---------------------|--------|-----------|---------|------------------|
| I. — GREEN FODDERS — Con. | | | | | |
| <i>(c) Legumes — Con.</i> | | | | | |
| Sulla, | 2 | 75 | 0.68 | 0.58 | 0.12 |
| Spring vetch, | 1 | 80 | 0.48 | 0.60 | 0.13 |
| Kldney vetch, | 1 | 80 | 0.59 | 0.37 | 0.10 |
| <i>(d) Mixed and Miscellaneous.</i> | | | | | |
| Vetch and oats, | 4 | 80 | 0.30* | 0.30 | 0.14 |
| Apple pomace, | 2 | 83 | 0.21 | 0.12 | 0.02 |
| Common buckwheat, | 1 | 85 | 0.44 | 0.54 | 0.09 |
| Japanese buckwheat, | 1 | 85 | 0.26 | 0.53 | 0.14 |
| Silver hull buckwheat, | 1 | 85 | 0.29 | 0.39 | 0.14 |
| Carrot tops, | 1 | 80 | 0.69 | 1.08 | 0.13 |
| Prickly comfrey, | 1 | 87 | 0.37 | 0.76 | 0.12 |
| Summer rape, | 1 | 85 | 0.34 | 0.78 | 0.10 |
| Sorghum, | 7 | 80 | 0.27 | 0.27 | 0.11 |
| Teosinte, | 1 | 70 | 0.47 | 1.18 | 0.06 |
| II. — SILAGE. | | | | | |
| Corn, | 7 | 80 | 0.42 | 0.39 | 0.13 |
| Corn and soy bean, | 1 | 76 | 0.65 | 0.36 | 0.35 |
| Millet, | 3 | 74 | 0.26 | 0.62 | 0.14 |
| Millet and soy bean, | 5 | 79 | 0.42 | 0.44 | 0.11 |
| III. — HAY AND DRY COARSE FODDERS. | | | | | |
| <i>(a) Meadow Grasses and Millets.</i> | | | | | |
| Barnyard millet, | 3 | 14 | 1.29 | 2.88 | 0.43 |
| Hungarian grass, | 1 | 14 | 1.29 | 1.79 | 0.52 |
| Italian rye grass, | 4 | 14 | 1.12 | 1.19 | 0.53 |
| Kentucky blue grass, | 2 | 14 | 1.20 | 1.54 | 0.39 |
| Meadow fescue, | 6 | 14 | 0.93 | 1.98 | 0.37 |
| Orchard grass, | 4 | 14 | 1.23 | 1.60 | 0.38 |
| Perennial rye grass, | 2 | 14 | 1.16 | 1.47 | 0.53 |
| Red top, | 4 | 14 | 1.07 | 0.95 | 0.33 |
| Timothy, | 3 | 14 | 1.20 | 1.42 | 0.33 |
| English hay (mixed grasses), | 12 | 14 | 1.29 | 1.52 | 0.29 |
| Rowen, | 13 | 14 | 1.72 | 1.58 | 0.48 |
| Branch grass, | 1 | 16 | 1.06 | 0.87 | 0.19 |
| Fox grass, | 1 | 16 | 1.18 | 0.95 | 0.18 |
| Salt hay (variety uncertain), | 1 | 16 | 1.05 | 0.64 | 0.23 |

* Too low; 0.43 nearer correct.

B. Fertilizer Ingredients of Fodder Articles — Continued.

| | Number of Analyses. | Water. | Nitrogen. | Potash. | Phosphoric Acid. |
|---|------------------------|--------|-----------|---------|---------------------|
| III.—HAY AND DRY COARSE FODDERS — <i>Con.</i> | | | | | |
| <i>(b) Cereal Fodders.</i> | | | | | |
| Corn stover, from field, | 17 | 40 | 0.69 | 0.92 | 0.20 |
| Corn stover, very dry, | 17 | 20 | 0.92 | 1.22 | 0.26 |
| Oats, | 3 | 15 | 2.45* | 1.90 | 0.65 |
| <i>(c) Legumes.</i> | | | | | |
| Alsike clover, | 6 | 15 | 2.26 | 2.10 | 0.63 |
| Mammoth red clover, | 3 | 15 | 2.14 | 1.16† | 0.52 |
| Medium red clover, | 2 | 15 | 2.01 | 2.11 | 0.41 |
| <i>(d) Straw.</i> | | | | | |
| Barley, | 2 | 15 | 0.95 | 2.03 | 0.19 |
| Soy bean, | 1 | 15 | 0.69 | 1.04 | 0.25 |
| Millet, | 1 | 15 | 0.68 | 1.73 | 0.18 |
| <i>(e) Mixed and Miscellaneous.</i> | | | | | |
| Vetch and oats, | 4 | 15 | 1.29† | 1.27 | 0.60 |
| Broom corn waste (stalks), | 1 | 10 | 0.87 | 1.87 | 0.47 |
| Palmetto root, | 1 | 12 | 0.54 | 1.37 | 0.16 |
| Spanish moss, | 1 | 15 | 0.61 | 0.56 | 0.07 |
| White daisy, | 1 | 15 | 0.26 | 1.18 | 0.41 |
| IV. — VEGETABLES, FRUITS, ETC. | | | | | |
| Apples, | 2 | 78 | 0.12 | 0.17 | 0.01 |
| Artichokes, | 1 | 78 | 0.46 | 0.48 | 0.17 |
| Beets, red, | 8 | 88 | 0.24 | 0.44 | 0.09 |
| Sugar beets, | 4 | 86 | 0.24 | 0.52 | 0.11 |
| Yellow fodder beets, | 1 | 89 | 0.23 | 0.56 | 0.11 |
| Mangolds, | 3 | 88 | 0.15 | 0.34 | 0.14 |
| Carrots, | 3 | 89 | 0.16 | 0.46 | 0.09 |
| Cranberries, | 1 | 89 | 0.08 | 0.10 | 0.03 |
| Parsnips, | 1 | 80 | 0.22 | 0.62 | 0.19 |
| Potatoes, | 5 | 80 | 0.29 | 0.51 | 0.08 |
| Japanese radish, | 1 | 93 | 0.08 | 0.40 | 0.05 |
| Turnips, | 4 | 90 | 0.17 | 0.38 | 0.12 |
| Ruta-bagas, | 3 | 89 | 0.19 | 0.49 | 0.12 |

* Too high; 1.90 nearer correct.

† Evidently below normal.

‡ Too low; 1.80 nearer correct.

B. Fertilizer Ingredients of Fodder Articles—Continued.

| | Number of Analyses. | Water. | Nitrogen. | Potash. | Phosphoric Acid. |
|--|------------------------|--------|-----------|---------|---------------------|
| V.—CONCENTRATED FEEDS. | | | | | |
| (a) <i>Protein.</i> | | | | | |
| Cotton-seed meal, | 24 | 7.0 | 7.22 | 1.85 | 2.50 |
| Linseed meal (new process), | 5 | 9.0 | 5.77 | 1.24 | 1.68 |
| Linseed meal (old process), | 4 | 8.5 | 5.36 | 1.20 | 1.77 |
| Chicago gluten meal, | 2 | 9.5 | 6.05 | 0.06 | 0.43 |
| King gluten meal, | 1 | 7.0 | 5.74 | 0.08 | 0.70 |
| Gluten meal (brand uncertain), | 5 | 8.5 | 5.09 | 0.05 | 0.42 |
| Buffalo gluten feed, | 5 | 8.5 | 4.24 | 0.06 | 0.34 |
| Dried brewers' grains, | 2 | 8.0 | 3.68 | 0.86 | 1.06 |
| Atlas gluten meal, | 1 | 8.0 | 4.97 | 0.17 | 0.24 |
| Wheat middlings, | 2 | 10.0 | 2.79 | 0.76 | 1.27 |
| Wheat bran, | 10 | 10.0 | 2.36 | 1.40 | 2.10 |
| Proteina, | 1 | 8.0 | 3.04 | 0.58 | 1.02 |
| Red adzinki bean, | 1 | 14.0 | 3.27 | 1.55 | 0.95 |
| White adzinki bean, | 1 | 14.0 | 3.45 | 1.53 | 1.00 |
| Saddle bean, | 1 | 14.0 | 2.08 | 2.09 | 1.49 |
| Soy bean (variety uncertain), | 2 | 14.0 | 5.58 | 2.10 | 1.97 |
| Soy bean meal, | 1 | 14.0 | 5.68 | 2.15 | 1.51 |
| Pea meal, | 1 | 10.0 | 3.04 | 0.98 | 1.81 |
| Peanut meal, | 1 | 8.0 | 7.84 | 1.54 | 1.27 |
| (b) <i>Starchy.</i> | | | | | |
| Ground barley, | 1 | 13.0 | 1.56 | 0.34 | 0.66 |
| Corn kernels, | 13 | 11.0 | 1.82 | 0.40 | 0.70 |
| Corn meal, | 3 | 14.0 | 1.92 | 0.34 | 0.71 |
| Corn and cob meal, | 29 | 11.0 | 1.38 | 0.46 | 0.56 |
| Common millet seed, | 2 | 12.0 | 2.00 | 0.45 | 0.95 |
| Japanese millet seed, | 1 | 12.0 | 1.58 | 0.35 | 0.63 |
| Oat kernels, | 1 | 11.0 | 2.05 | — | — |
| Buckwheat hulls, | 1 | 12.0 | 0.49 | 0.52 | 0.07 |
| Cocoa dust, | 1 | 7.0 | 2.30 | 0.63 | 1.34 |
| Corn cobs, | 8 | 8.0 | 0.52 | 0.63 | 0.06 |
| Cotton hulls, | 3 | 11.0 | 0.75 | 1.08 | 0.18 |
| Oat feed, | 1 | 7.0 | 1.46 | 0.72 | 0.60 |
| Peanut feed, | 2 | 10.0 | 1.46 | 0.79 | 0.23 |

B. Fertilizer Ingredients of Fodder Articles — Concluded.

| | Number of Analyses. | Water. | Nitrogen. | Potash. | Phosphoric Acid. |
|--|------------------------|--------|-----------|---------|---------------------|
| V.—CONCENTRATED FEEDS—<i>Con.</i> | | | | | |
| <i>(b) Starchy—Con.</i> | | | | | |
| Peanut husks, | 1 | 13.0 | 0.80 | 0.48 | 0.13 |
| Louisiana rice bran, | 1 | 11.0 | 1.42 | 0.83 | 1.70 |
| Rye feed, | 1 | 11.0 | 1.92 | 0.97 | 1.54 |
| Rye middlings, | 1 | 11.0 | 1.87 | 0.82 | 1.28 |
| Schumacher's stock feed, | 1 | 8.0 | 1.80 | 0.63 | 0.83 |
| Victor corn and oat feed, | 2 | 10.0 | 1.38 | 0.61 | 0.59 |
| Damaged wheat, | 1 | 13.0 | 2.26 | 0.51 | 0.83 |
| Wheat flour, | 2 | 12.0 | 2.02 | 0.36 | 0.35 |
| <i>(c) Poultry.</i> | | | | | |
| American poultry food, | 1 | 8.0 | 2.22 | 0.52 | 0.98 |
| Wheat meal, | 1 | 8.0 | 11.21 | 0.30 | 0.73 |
| VI.—DAIRY PRODUCTS. | | | | | |
| Whole milk, | 297 | 86.4 | 0.57 | 0.19* | 0.16* |
| Human milk, | 3 | 88.1 | 0.24 | — | — |
| Skim-milk, | 22 | 90.3 | 0.59 | 0.18† | 0.20† |
| Buttermilk, | 1 | 91.1 | 0.51 | 0.05 | 0.04 |
| Whey, | 1 | 93.7 | 0.10 | 0.07 | 0.17 |
| Butter, | 117 | 12.5 | 0.19 | — | — |

* From Farrington and Woll.

† From Woll's handbook.

C. ANALYSES OF DAIRY PRODUCTS.

[Figures equal percentages or pounds in 100.]

| NAME. | Number of Analyses. | SOLIDS. | | | FAT. | | | Curd (N. × 6.25). | Salt. | Ash. |
|---|---------------------|----------|----------|----------|----------|----------|----------|-------------------|-------|-------|
| | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | | | |
| Whole milk, | 3,281 | 19.55 | 10.02 | 13.57 | 10.70 | 1.50 | 4.32 | 3.54* | - | 0.73† |
| Human milk, | 3 | 13.59 | 10.50 | 11.87 | 3.77 | 1.66 | 2.52 | 1.48 | - | 0.24 |
| Colostrum, | 2 | 24.75 | 21.25 | 23.00 | 3.00 | 3.00 | 3.00 | 2.84† | - | 1.00 |
| Skim-milk (largely from Cooley process), | 358 | 10.48 | 7.68 | 9.20 | 1.80 | 0.05 | 0.32 | - | - | - |
| Buttermilk, | 31 | 9.86 | 6.83 | 8.33 | 0.38 | 0.11 | 0.27 | - | - | - |
| Cream (from Cooley process), | 203 | 32.78 | 18.12 | 26.10 | 25.00 | 10.53 | 17.60 | - | - | - |
| Butter (salted), | 117 | 94.84 | 83.41 | 87.56 | 89.33 | 77.95 | 83.31 | 1.17§ | 3.17§ | - |
| Butter (fresh), | 14 | 85.36 | 72.49 | 82.24 | 85.05 | 72.21 | 81.48 | 0.76 | - | - |
| Whole-milk cheese, | 2 | - | - | 63.51 | - | - | 35.83 | 24.41 | - | 3.27 |
| Cheese from partially skimmed milk, | 2 | - | - | 60.23 | - | - | 25.62 | 31.18 | - | 3.44 |
| Skin-milk cheese, | 2 | - | - | 55.32 | - | - | 16.72 | 34.09 | - | 4.51 |
| Cheese from skim-milk, with addition of buttermilk, | 1 | - | - | 51.62 | - | - | 18.35 | 28.63 | - | 4.65 |
| Genuine oleomargarine cheese, | 1 | - | - | 62.10 | - | - | 31.66 | 25.94 | - | 4.50 |

* Average of 297 analyses. † Average of 253 analyses. ‡ Nitrogen. § Average of 115 analyses.

D. COEFFICIENTS OF DIGESTIBILITY OF AMERICAN FEED
STUFFS. — EXPERIMENTS MADE IN THE UNITED STATES.

COMPILED BY J. B. LINDSEY, ASSISTED BY NATHAN J. HUNTING.

Experiments with Ruminants.
Experiments with Swine.
Experiments with Horses.
Experiments with Poultry.

DEC. 31, 1901.

Experiments with Ruminants.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen-free Extract (Per Cent.). | Fat (Per Cent.). |
|---|---------------------------|----------------|-------------------------|-----------------------------|------------------|----------------------|--------------------|------------------------------------|------------------|
| I.—GREEN FODDERS. | | | | | | | | | |
| <i>(a) Meadow Grasses and Millets.</i> | | | | | | | | | |
| Barley millet in blossom (Mass.), | 3 | 6 { | 67-76 70 | - | 45-67 56 | 58-70 65 | 71-77 73 | 65-77 71 | 54-67 58 |
| Japanese millet, bloom, to early seed (Storrs), | 2 | 3 { | - | 62-66 64 | 52-58 55 | 45-57 50 | 59-63 62 | 64-68 67 | 60-72 68 |
| Hungarian grass, early to late bloom, | 3 | 8 { | 61-71 66 | 61-74 68 | - | 59-72 63 | 65-76 70 | 64-71 67 | 48-85 62 |
| Grass, meadow, young, | 1 | 1 | 69 | - | - | 65 | 74 | 72 | 55 |
| Grass, meadow, young, and dried, | 1 | 1 | 71 | - | - | 71 | 77 | 73 | 60 |
| Grass, timothy, | 1 | 3 { | 63-65 64 | - | 31-33 32 | 48-48 48 | 54-53 56 | 65-67 66 | 52-54 52 |
| Grass, timothy rowen, | 1 | 2 { | - | 65-67 66 | - | 72-72 72 | 60-68 64 | 67-68 68 | 51-55 52 |
| <i>(b) Cereal Fodders.</i> | | | | | | | | | |
| Corn fodder, dent, immature, | 4 | 11 { | 64-74 68 | - | - | 56-80 66 | 60-76 67 | 64-79 71 | 37-83 68 |
| Corn fodder, dent, milk, | 3 | 9 | 70 | - | - | 61 | 64 | 76 | 78 |
| Corn fodder, dent, mature, | 7 | 13 | 66 | - | - | 53 | 52 | 74 | 76 |
| Corn fodder, dent, mature, B. & W., coarse, | 1 | 2 { | 51-54 52 | - | - | 20-28 24 | 46-47 46 | 57-61 59 | 74-82 78 |

| | | | | | | | | | |
|---|---|----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Corn fodder, sweet, milk stage, | 1 | 2 | 77-78 77 | - | - | 77-78 77 | 74-76 75 | 80-81 81 | 73-74 74 |
| Corn fodder, sweet, roasting stage, | 9 | 12 | - | 67-79 72 | 22-61 48 | 52-69 62 | 54-72 60 | 73-82 77 | 62-82 74 |
| Sorghum, blossom, | 1 | 2 | 73-73 73 | - | - | 51-56 53 | 74-75 75 | 78-78 78 | 81-82 81 |
| Sorghum, Early Amber, past blossom, | 1 | 2 | 61-62 61 | - | - | 38-42 40 | 42-45 42 | 70-71 71 | - 67 |
| Sorghum, average both samples, | 2 | 4 | 67 | - | - | 46 | 59 | 74 | 74 |
| Barley fodder, bloom, | 2 | 4 | - | 62-71 67 | - | 69-73 72 | 49-66 61 | 69-76 71 | 56-63 60 |
| Barley fodder, seeds forming, | 2 | 2 | - | 66-71 68 | 40-44 42 | 67-71 69 | 47-65 56 | - 74 | 48-50 49 |
| Oat fodder, bloom (?), | 1 | 2 | - | 63-65 64 | - | 75-76 75 | 58-63 60 | 63-63 63 | 68-71 70 |
| Oat fodder, early seed, | 2 | 3 | - | 56-63 60 | 49-68 60 | 68-73 71 | 43-56 51 | 60-67 62 | 67-72 69 |
| Rye fodder, heading, | 1 | 2 | 73-74 74 | - | - | 79-80 79 | 80-80 80 | 70-71 71 | 74-74 74 |
| (c) Legumes. | | | | | | | | | |
| Clover, red, late blossom, | 1 | 2 | 65-67 66 | - | - | 66-68 67 | 52-53 53 | 76-79 78 | 63-66 65 |
| Clover, rowen, late blossom, | 1 | 2 | - | 60-62 61 | - | 61-62 62 | 51-54 52 | 64-68 65 | 60-61 61 |
| Clover, crimson, late blossom, | 1 | 3 | - | 68-70 69 | - | 77-77 77 | 54-58 56 | 74-75 74 | 63-69 66 |
| Clover, average three samples, | 3 | 7 | - | - | - | 70 | 54 | 72 | 64 |
| Cow-peas, ready for selling, | 2 | 4 | 66-77 68 | 72-76 74 | 19-28 23 | 73-77 76 | 57-62 60 | 76-84 81 | 56-62 59 |

Experiments with Ruminants — Continued.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen-free Extract (Per Cent.). | Fat (Per Cent.). |
|---|---------------------------|----------------|-------------------------|-----------------------------|------------------|----------------------|--------------------|------------------------------------|------------------|
| I.—GREEN FODDERS— <i>Con.</i> | | | | | | | | | |
| (c) <i>Legumes</i> — <i>Con.</i> | | | | | | | | | |
| Canada field peas, before bloom, | 1 | 2 | 68 } 63 } | 71-72 71 | - | 81-83 82 | 62-62 62 | 71-71 71 | 50-55 52 |
| Canada field peas, bloom to seed, | 1 | 3 | 60-65 63 | - | 40-45 43 | 79-80 80 | 40-52 46 | 72-75 74 | 45-53 49 |
| Soy beans, variety uncertain, before bloom, | 1 | 2 | - | 64-67 66 | - | 77-80 79 | 45-55 50 | 71-73 72 | 50-58 54 |
| Soy beans, variety uncertain, seeding, | 1 | 2 | - | 61-63 62 | - | 68-71 69 | 38-43 41 | 72-75 73 | 49-59 54 |
| Soy beans, medium green, full bloom, | 1 | 2 | - | 62-63 63 | 22-28 25 | 76-78 77 | 45-49 47 | 69-73 71 | 46-54 50 |
| Soy beans, medium green, seeding, | 1 | 2 | - | 67-67 67 | 16-29 23 | 74-76 75 | 49-50 50 | 75-77 76 | 54-61 58 |
| Soy beans, medium green, seeding, | 1 | 4 | - | 65-69 67 | - | 74-78 76 | 39-44 44 | 76-81 79 | 31-46 36 |
| Soy beans, average all trials, | 5 | 12 | - | 65 | ? | 75 | 46 | 75 | 48 |
| Spring vetch (<i>Vicia sativa</i>), | 1 | 2 | 62-62 62 | - | 17 | 71-72 71 | 42-46 44 | 75-77 76 | 57-60 59 |
| Hairy vetch (<i>Vicia villosa</i>), | 3 | 12 | 66-78 71 | - | 33-55 44 | 79-88 83 | 52-73 63 | 68-83 76 | 63-82 72 |

(d) Mixed and Miscellaneous.

| | | | | | | | | | | |
|--|---|----|---|--------------|-------------|-------------|-------------|----------------|-------------|-------------|
| Oats and spring vetch, bloom, | 1 | 3 | { | 65-69 67 | - | 49-55 53 | 73-76 75 | 65-72 68 | 66-70 68 | 42-52 47 |
| Oats and peas, bloom, | 2 | 5 | { | 69-72 70 | 67-69 68 | 45-52 49 | 68-82 74 | 54-70 64 | 66-77 72 | 51-74 64 |
| Oats and peas, partly seeded, | 3 | 5 | { | - | 58-70 62 | 36-63 47 | 68-83 74 | 48-67 55 | 56-67 63 | 55-74 64 |
| Winter wheat and hairy vetch, | 1 | 3 | { | 68-69 68 | - | 40-46 44 | 75-78 77 | 66-67 67 | 71-72 72 | 56-57 57 |
| Barley and peas, bloom, | 3 | 4 | { | - | 55-71 65 | 52-55 54 | 73-81 75 | 38-61 52 | 56-76 68 | 54-65 59 |
| Dwarf Essex rape, first growth, | 1 | 2 | { | 88-88 88 | - | 76-77 76 | 90-91 90 | 90-90 90 | 94-94 94 | 54-55 54 |
| Dwarf Essex rape, second growth, | 1 | 2 | { | 81 | - | 47-51 49 | 86-89 87 | 84-84 84 | 90-91 90 | 42-44 43 |
| Dwarf Essex rape, average, | 2 | 4 | { | 85 | - | 63 | 89 | 87 | 92 | 48 |
| Skim-milk, with sheep, | 1 | 3 | { | 96-102 97 | - | 46-74 62 | 93-96 94 | - | - | 100 |
| II.—SILAGE. | | | | | | | | | | |
| Corn silage, dent, immature, | 5 | 13 | { | 60-68 64 | - | - | 42-65 54 | (?) - 78 70 | 60-70 66 | 64-85 71 |
| Corn silage, dent, mature, | 6 | 17 | { | 60-74 64 | - | - | 45-63 52 | 45-80 62 | 63-73 69 | 78-90 85 |
| Corn silage, dent, stage uncertain, | 1 | 4 | { | 53-67 60 | - | - | 19-34 24 | 43-64 56 | 61-76 68 | 55-79 70 |
| Corn silage, dent, Pride of North, mature, | 1 | 2 | { | 72-76 74 | - | 24-28 26 | - | 72-73 73 | 81-83 82 | 72-82 77 |
| Corn silage, flint, mature, small varieties, | 4 | 11 | { | 68-78 75 | 66-80 77 | - | 48-73 65 | 75-79 77 | 71-83 79 | - 82 |

Experiments with Ruminants — Continued.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen-free Extract (Per Cent.). | Fat (Per Cent.). |
|--|---------------------------|----------------|-------------------------|-----------------------------|------------------|----------------------|--------------------|------------------------------------|------------------|
| II. — SILAGE — <i>Con.</i> | | | | | | | | | |
| Corn silage, flint, large white, partly eared, . . . | 1 | 2 | 69—70 70 | 72—73 72 | 31—37 34 | 56—56 56 | 72—72 72 | 75—76 76 | 72—74 73 |
| Corn silage, fine crushed, steers, . . . | 1 | 2 | 60—68 64 | - | - | 32—44 38 | 72—78 75 | 60—70 65 | 75—77 76 |
| Corn silage, fine crushed, sheep, . . . | 1 | 2 | 51—56 54 | - | - | 21—22 21 | 59—68 64 | 53—57 55 | 67—69 68 |
| Corn silage, mature, fed raw, . . . | 1 | 1 | - | - | - | 45 | 59 | 71 | 86 |
| Corn silage, mature, cooked, . . . | 1 | 1 | - | - | - | 39 | 70 | 75 | 87 |
| Corn silage, sweet, mature, . . . | 1 | 2 | 67—70 68 | 68—72 70 | - | 53—55 54 | 68—74 71 | 71—73 72 | 82—85 83 |
| Cow-pea silage, steers, . . . | 1 | 4 | 59—60 60 | - | - | 57—58 57 | 50—54 52 | 72—73 72 | 62—64 63 |
| Clover silage, late bloom, . . . | 1 | 2 | 52—52 52 | 52—54 53 | 37—51 44 | 39—40 40 | 55—55 55 | 54—58 56 | 48—60 54 |
| Oat and pea silage, . . . | 1 | 2 | 63—68 65 | 63—70 67 | 52—53 52 | 74—75 75 | 58—65 61 | 64—70 67 | 73—77 75 |
| Soy bean silage, goats, . . . | 1 | 2 | 52—66 59 | - | - | 71—80 76 | 47—62 55 | 46—58 52 | 66—77 72 |
| Soy bean silage, steers, . . . | 1 | 2 | 50—50 50 | - | - | 54—56 55 | 42—44 43 | 61—61 61 | 47—52 49 |
| Soy bean and barnyard millet silage, sheep, . . . | 1 | 4 | 54—65 59 | - | - | 55—62 57 | 61—73 69 | 54—63 59 | 69—75 72 |

| | | | | | | | | | | |
|---|----|----|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Soy bean and corn silage, sheep, | 1 | 3 | { | 66-72 69 | - | - | 63-67 65 | 59-73 65 | 73-78 75 | 80-84 82 |
| Silage, mixture of corn, sunflower heads and horse beans,* | 1 | 2 | { | 64-68 66 | 66-70 68 | 40-41 41 | 60-65 63 | 56-64 60 | 71-74 72 | 75-78 77 |
| Silage, mixture of corn, sunflowers (whole plant) and horse beans.† | 1 | 2 | { | 64-67 65 | 68-71 69 | 20-31 26 | 57-59 58 | 63-68 65 | 72-75 74 | 72-76 74 |
| III.—HAY AND DRY COARSE FODDERS. | | | | | | | | | | |
| (a) <i>Meadow Grasses and Millets.</i> | | | | | | | | | | |
| Timothy, in bloom, | 3 | 5 | { | 56-66 60 | 56-67 60 | - | 50-60 56 | 56-62 58 | 57-72 63 | 51-62 57 |
| Timothy, past bloom, | 5 | 10 | { | 47-61 53 | 48-62 54 | - | 39-50 45 | 37-57 47 | 56-70 60 | 35-61 53 |
| Timothy, average all trials, | 20 | 48 | { | 56 | 57 | 36 | 48 | 51 | 62 | 51 |
| Timothy, fed with cotton-seed meal, 16 hay, 1 meal, | 1 | 2 | { | 52-56 54 | - | 17-28 22 | 24-32 28 | 46-52 49 | 61-63 62 | 36-37 36 |
| Timothy, fed with cotton-seed meal, 12 hay, 1 meal, | 1 | 2 | { | 49-55 52 | - | 9-30 20 | 27-38 32 | 43-51 47 | 58-62 60 | 52-54 53 |
| Timothy, fed with cotton-seed meal, 8 hay, 1 meal, . | 1 | 2 | { | 44-48 46 | - | 3-10 6 | 18-23 21 | 40-44 42 | 53-56 54 | 42-45 44 |
| Timothy, fed with cotton-seed meal, 4 hay, 1 meal, . | 1 | 2 | { | 45-46 46 | - | - | 4-4 4 | 42-43 43 | 56-75 57 | 44-66 55 |
| Timothy, fed with cotton-seed meal, 2 hay, 1 meal, . | 1 | 2 | { | 48-56 52 | - | 13 | - | 34-44 39 | 65-71 68 | 72-74 73 |
| Timothy, fed with cotton-seed meal, 1 hay, 1 meal, . | 1 | 2 | { | 47-52 49 | - | 19-23 21 | - | 24-26 25 | 68-78 73 | 79-87 83 |
| Timothy, fed with cotton-seed meal, average all trials, | 6 | 12 | { | 50 | - | 16 | 20 | 41 | 62 | 57 |
| Timothy and clover, poorly cured, | 1 | 2 | { | 54-55 55 | - | - | 37-38 38 | 52-54 53 | - | - |

* Proportion of one acre corn, one-fourth acre sunflower heads and one-half acre horse beans.

† Same proportions as above.

Experiments with Ruminants — Continued.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen- free Extract (Per Cent.). | Fat (Per Cent.). |
|--|------------------------------------|-------------------|-------------------------------|-----------------------------------|---------------------|-------------------------|-----------------------|--|---------------------|
| III. — HAY AND DRY COARSE FODDERS — Con. | | | | | | | | | |
| (a) <i>Meadow Grasses and Millets</i> — Con. | | | | | | | | | |
| Mixed grasses, rich in protein, | 11 | 46 } | 54—63 60 | — | 44—53 48 | 40—65 59 | 49—66 60 | 56—65 61 | 41—58 50 |
| Mixed grasses, timothy predominating, | 2 | 4 | 55 | — | 35 | 54 | 58 | 55 | 41 |
| Red top, | 2 | 3 } | 58—62 60 | 59—64 61 | — | 60—62 61 | 61—62 61 | 59—65 62 | 44—59 51 |
| Orchard grass, ten days after bloom, | 1 | 1 | 54 | 56 | — | 59 | 58 | 54 | 54 |
| Orchard grass, stage not given, | 1 | 2 } | 57—60 59 | — | — | 60—60 60 | 60—67 64 | 55—57 56 | 55—57 56 |
| Orchard grass, average both samples, | 2 | 3 | 56 | 56 | — | 60 | 61 | 55 | 55 |
| Meadow fescue (<i>Festuca elatior pratensis</i>), | 1 | 2 } | 60—61 61 | — | — 46 | 51—53 52 | — 67 | 58—60 59 | 53—54 54 |
| Tall oat grass, late blossom (<i>Arrhenatherum elatius</i>), | 1 | 2 } | 54—57 55 | — | 39—43 41 | — 51 | 53—57 55 | 56—59 58 | 54—58 56 |
| Kentucky blue grass (<i>Poa pratensis</i>), | 1 | 1 | 56 | — | 42 | 57 | 63 | 53 | 43 |
| Canada blue grass (<i>Poa compressa</i>), | 1 | 2 } | 62—63 62 | — | 42—42 42 | 43—44 43 | 70—71 71 | 63—63 63 | 36—39 37 |
| Rowen, mixed grasses, | 3 | 12 } | — | 63—68 65 | — | — 70 | 62—72 66 | 60—69 65 | 44—51 47 |
| Rowen, chiefly timothy, | 1 | 4 } | — | 62—67 64 | — | 66—69 68 | 62—73 66 | 60—65 63 | 48—51 49 |

| | | | | | | | | | |
|--|---|----|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Rowen, average all trials, | 4 | 16 | - | 65 | - | 69 | 66 | 64 | 47 |
| Pasture grass, | 1 | 3 | 73 | 73 | 52 | 73 | 76 | 74 | 67 |
| Meadow, swale or swamp, | 1 | 2 | 38-40 39 | - | - | 31-37 34 | 30-36 33 | - | - |
| Blue-joint, bloom, | 1 | 2 | 67-70 69 | 68-71 70 | - | 68-72 70 | 71-73 72 | 66-71 69 | 51-53 52 |
| Blue-joint, past bloom, | 1 | 1 | 40 | 42 | - | 57 | 37 | 43 | 37 |
| Buffalo grass (<i>Bulbilis Dactyloides</i>), | 1 | 1 | 55 | - | 6 | 54 | 65 | 62 | 62 |
| Prairie grass (<i>Sporobolus Asper</i>), | 1 | 1 | 56 | - | 25 | 18 | 61 | 61 | 57 |
| Johnson grass (<i>Andropogon halepensis</i>), | 2 | 3 | 57 | - | - | 40 | 68 | 57 | 38 |
| Crab grass, ripe (<i>Eragrostis Neo Mexicana</i>), | 3 | 8 | 47-57 53 | - | 29-52 43 | 30-56 38 | 50-66 60 | 50-59 53 | 30-52 43 |
| Chess or cheat (<i>Bromus secalinus</i>), | 1 | 1 | 45 | - | 23 | 42 | 46 | 49 | 32 |
| Black grass (<i>Juncus Gerardi</i>), | 2 | 5 | 50-62 56 | - | 67-71 69 | 53-63 58 | 50-66 59 | 46-59 52 | 37-51 44 |
| Fox grass (<i>Spartina patens</i>), | 3 | 7 | 51-56 54 | - | 57-59 58 | 56-63 60 | 46-60 53 | 51-55 53 | 17-51 36 |
| Branch grass (<i>Distichlis spicata</i>), | 2 | 5 | 49-57 52 | - | - | - | 48-57 54 | 45-55 49 | 27-42 35 |
| Salt hay mixture, fox and branch grasses, etc., | 1 | 2 | 52-56 54 | - | 68-70 69 | 41-43 42 | 54-61 58 | 51-54 52 | 26-30 28 |
| Flat sage (<i>Spartina stricta maritima var.</i>), | 1 | 3 | 55-58 57 | - | 61-62 62 | 50-55 52 | 60-61 60 | 54-57 55 | 33-40 35 |
| Barnyard millet, | 1 | 3 | 57-58 57 | - | 63-64 63 | 63-64 64 | 60-64 62 | 50-52 52 | 44-50 46 |
| Millet (<i>Chenopodium italicum</i>), | 1 | 2 | 52-58 56 | - | 16-32 24 | 30-32 31 | 60-66 63 | 52-59 56 | 48-52 50 |

Experiments with Ruminants — Continued.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen-free Extract (Per Cent.). | Fat (Per Cent.). |
|---|---------------------------|----------------|-------------------------|-----------------------------|------------------|----------------------|--------------------|------------------------------------|------------------|
| III. — HAY AND DRY COARSE FODDERS — <i>Con.</i> | | | | | | | | | |
| (a) <i>Meadow Grasses and Millets — Con.</i> | | | | | | | | | |
| Hungarian, | 1 | 2 | 64—66 65 | 66—67 66 | - | - 60 | 67—68 68 | 67—67 67 | - 64 |
| Golden millet, | 1 | 1 | 54 | - | 31 | 23 | 56 | 58 | 49 |
| Cat-tail millet (<i>Pennisetum spicatum</i>), | 1 | 2 | 61—64 62 | - | - | 61—65 63 | 65—68 67 | 58—60 59 | 45—48 46 |
| (b) <i>Cereal Fodders.</i> | | | | | | | | | |
| Corn stover, average all trials, | 6 | 18 | 53—62 57 | - | - | 11—55 36 | 63—74 66 | 54—64 59 | 49—77 65 |
| Corn stover, | 1 | 4 | 53—55 53 | 56—58 57 | - | 11—22 17 | 63—67 64 | 54—59 57 | 69—77 76 |
| Corn stover, without pith, | 1 | 3 | 54—57 55 | 55—59 57 | - | 16—28 20 | 60—65 63 | 55—58 57 | 70—75 72 |
| New corn product, stover minus pith, ground, . | 1 | 3 | 63—64 63 | - | 46—55 49 | 57—62 60 | 60—61 61 | 65—66 66 | 82—83 83 |
| New corn product, steamed, | 1 | 3 | 51—59 56 | - | 47—55 50 | 59—60 60 | 37—54 48 | 57—62 59 | 70—85 80 |
| Average three trials, stover minus pith, . . . | 3 | 9 | 58 | - | - | 47 | 57 | 61 | 78 |
| Corn stover, tops and blades, | 1 | 2 | 59—60 60 | - | - | 54—57 55 | 71—72 71 | 62—63 62 | 71—72 71 |
| Corn stover, blades and husks, | 1 | 4 | 60—68 65 | - | 15—35 23 | 41—55 48 | 67—76 73 | 64—71 66 | 53—64 58 |

| | | | | | | | | | |
|--|---|---|-------------|---|----|-------------|-------------|-------------|-------------|
| Corn stover, leaves, | 1 | { | 55—56 56 | - | - | 43—69 56 | 54—67 61 | 57—61 59 | 61—65 63 |
| Corn stover, below ear, | 1 | { | 64—69 67 | - | - | 15—27 21 | 71—75 74 | 65—73 69 | 79—80 80 |
| Corn stover, above ear, | 1 | { | 52—58 55 | - | - | 17—27 22 | 69—72 71 | 50—57 54 | 62—65 64 |
| Corn husks, | 1 | { | 71—73 72 | - | - | 24—35 30 | 78—81 80 | 75 75 | 23—42 33 |
| Corn leaves, | 1 | { | 62—67 65 | - | - | 28—41 35 | 75—80 78 | 66—70 68 | 52—59 56 |
| Kafir corn stover, shredded, | 1 | { | 54—58 56 | - | - | 29—34 30 | 65—69 67 | 56—60 58 | 77—81 79 |
| Kafir corn stover, | 1 | { | 63 | - | 43 | 50 | 67 | 67 | 60 |
| Kafir corn stover, average all trials, | 2 | { | 57 | - | 24 | 34 | 67 | 60 | 75 |
| Flint corn fodder, ears forming, | 1 | { | 69—72 70 | - | - | 69—73 70 | 72—73 72 | 71—73 71 | 63—71 67 |
| Flint corn fodder, mature, | 5 | { | 63—73 70 | - | - | 56—79 64 | 69—80 76 | 63—78 71 | 59—79 71 |
| Bent corn fodder, ears not formed, | 4 | { | 61—70 65 | - | - | 57—67 62 | 63—77 71 | 57—70 64 | 59—72 66 |
| Bent corn fodder, immature, B. & W., | 1 | { | 51—64 57 | - | - | 20—36 27 | 45—74 59 | 57—66 61 | 66—84 76 |
| Bent corn fodder, in milk, | 5 | { | 59—66 63 | - | - | 44—51 50 | 50—71 64 | 61—69 66 | 67—79 75 |
| Bent corn fodder, mature, ears ground, | 2 | { | 64—70 67 | - | - | 36—47 43 | 62—73 68 | 70—77 74 | 59—77 66 |
| Bent corn fodder, mature, | 8 | { | 57—70 66 | - | - | 30—61 46 | 43—73 61 | 61—81 73 | 59—82 72 |

Experiments with Ruminants — Continued.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen- free Extract (Per Cent.). | Fat (Per Cent.). |
|--|------------------------------------|-------------------|-------------------------------|-----------------------------------|---------------------|-------------------------|-----------------------|--|---------------------|
| III.—HAY AND DRY COARSE FODDERS — <i>Con.</i> | | | | | | | | | |
| (b) <i>Cereal Fodders</i> — <i>Con.</i> | | | | | | | | | |
| Corn fodder, flint and dent, mature, | 13 | 33 | 57-73 67 | - | - | 30-79 52 | 43-80 66 | 61-81 72 | 56-82 72 |
| Corn fodder, sweet, mature, | 3 | 6 | 60-71 67 | 62-74 70 | - | 54-73 64 | 70-77 74 | 57-73 68 | 63-71 74 |
| Kafir corn fodder, | 1 | 4 | 59-62 61 | - | 5-11 8 | 34-42 38 | 56-63 60 | 64-68 66 | 57-67 61 |
| Sorghum fodder, leaves, | 1 | 2 | 60-66 63 | - | - | 59-62 61 | 65-76 70 | 62-67 65 | 46-47 47 |
| Sorghum bagasse, | 1 | 1 | 61 | - | - | 14 | 64 | 65 | 46 |
| Oat hay, bloom to milk, | 2 | 6 | 51-59 55 | 50-61 55 | 35-54 45 | 47-66 57 | 54-71 58 | 47-58 53 | 44-65 53 |
| Oat hay, milk to dough, | 4 | 14 | 48-60 54 | 48-61 54 | 20-54 37 | 34-60 52 | 39-62 48 | 49-62 56 | 52-72 64 |
| Oat hay, average all trials, | 6 | 20 | 54 | 54 | 39 | 53 | 51 | 55 | 60 |
| Barley hay, | 1 | 4 | 59 | 62 | - | 65 | 62 | 63 | 41 |
| Oat straw, | 1 | 2 | 49-52 50 | 51-53 52 | - | - | 57-58 58 | 52-55 53 | 35-41 38 |

(c) Legumes.

| | | | | | | | | | | |
|---|----|----|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Alfalfa, first crop, budded to full bloom, . . . | 3 | 6 | { | 56-63 59 | - | 34-50 42 | 61-70 65 | 31-44 40 | 68-76 72 | 26-40 35 |
| Alfalfa, second crop, budded to full bloom, . . . | 3 | 6 | { | 58-62 60 | - | 38-54 46 | 64-74 70 | 41-49 44 | 70-74 72 | 36-45 42 |
| Alfalfa, third crop, . . . | 1 | 2 | { | 56-60 58 | - | 40-49 44 | 68-70 69 | 28-40 34 | 71-71 71 | 28-45 42 |
| Alfalfa, average three crops, . . . | 7 | 14 | | 60 | - | 44 | 68 | 41 | 72 | 39 |
| Alfalfa, average all trials, . . . | 13 | 22 | | 61 | - | 46 | 70 | 43 | 72 | 43 |
| Alsike clover, full to late bloom, . . . | 4 | 9 | { | 55-64 59 | 56-65 60 | - 42 | 64-71 66 | 40-59 50 | 59-74 66 | 21-69 38 |
| Red clover, . . . | 6 | 15 | { | 51-67 58 | 52-66 54 | 0-41 28 | 47-69 59 | 44-70 56 | 57-72 65 | 40-70 58 |
| Clover rowen, . . . | 2 | 4 | { | - | 58-60 59 | 42-50 46 | 60-69 65 | 45-51 47 | 62-64 63 | 58-60 60 |
| White clover, . . . | 1 | 1 | | 66 | 67 | - | 73 | 61 | 70 | 51 |
| Crimson clover, . . . | 3 | 9 | { | 57-65 62 | 52-58 56 | - | 64-73 69 | 32-58 45 | 52-74 62 | 29-54 44 |
| Sand or hairy vetch, . . . | 1 | 6 | { | 68-71 69 | - | 34-46 42 | 81-83 82 | 60-63 61 | 71-75 73 | 69-74 70 |
| Soy bean, . . . | 1 | 2 | { | 62-63 62 | - | - | 70-72 71 | 59-62 61 | 66-71 69 | 19-40 29 |
| Cow-pea, . . . | 1 | 2 | { | - 59 | - | - | 64-65 65 | 41-45 43 | - 71 | 46-54 50 |
| Peanut vine, . . . | 1 | 2 | { | 59-60 60 | - | - | 63-64 63 | 51-53 52 | 69-70 70 | 62-70 66 |

Experiments with Ruminants — Continued.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen- free Extract (Per Cent.). | Fat (Per Cent.). |
|---|------------------------------------|-------------------|-------------------------------|-----------------------------------|---------------------|-------------------------|-----------------------|--|---------------------|
| III. — HAY AND DRY COARSE FODDERS — <i>Con.</i> | | | | | | | | | |
| (d) <i>Mixed and Miscellaneous.</i> | | | | | | | | | |
| Oat and pea, | 2 | 7 | 56-67 61 | 56-67 60 | 54-65 58 | 69-78 73 | 50-64 58 | 54-66 61 | 51-69 59 |
| Oat and sand vetch, | 1 | 2 | 55-55 55 | 56-56 56 | 43-46 44 | 64-66 65 | 48-50 49 | 58-59 59 | 58-67 63 |
| Oat and spring vetch, | 2 | 5 | 57-63 59 | - 60 | - 60 | 60-71 65 | 47-67 57 | 34-65 59 | 17-76 52 |
| Oat and vetch, average, | 3 | 7 | 58 | 58 | 56 | 65 | 55 | 59 | 55 |
| Wheat and sand vetch, | 1 | 3 | 64-65 64 | - - | 33-37 35 | 70-71 71 | 63-66 65 | 67-67 67 | 62-67 64 |
| Cotton-seed hulls, | 4 | 13 | 35-47 41 | - - | - - | 0-25 6 | .5-58 47 | 13-46 34 | 58-89 79 |
| Cotton-seed feed (4 to 1, sheep), | 2 | 6 | 54-60 56 | - - | 23-35 28 | 36-45 41 | 51-60 56 | 57-60 59 | 86-94 91 |
| Cotton-seed feed (5 to 1, steers), | 1 | 3 | 42-45 43 | - - | 20-24 22 | 32-41 36 | 28-33 31 | 50-59 54 | 83-86 84 |
| Cotton-seed feed (7 to 1 and 6 to 1, steers), | 1 | 3 | 45-46 46 | - - | - 28 | 44-46 45 | 34-40 37 | 50-51 50 | 81-82 82 |
| Cotton-seed feed (4 to 1, steers), | 1 | 2 | 54 | - | 46 | 54 | 45 | 58 | 85 |
| Cotton-seed feed (3 to 1 to 2 to 1, steers), | 2 | 9 | 54 | - | 32 | 64 | 47 | 54 | 85 |
| Average both trials (4 to 1), | 3 | 8 | 56 | - | 33 | 44 | 53 | 59 | 90 |

| | | | | | | | | | |
|--|---|----|-------------|--------------|-------------|-------------|---------------|----------------|--------------|
| Average all trials, | 7 | 23 | 52 | - | 30 | 51 | 46 | 55 | 86 |
| Parson's "Six-dollar" feed, | 1 | 2 | 55-56 56 | - | 10-14 12 | 56-62 59 | 45-50 47 | 63-65 64 | 80-81 81 |
| Wild oat grass (<i>Danthonia spicata</i>), | 2 | 3 | 60-68 64 | 61-69 65 | - | 49-68 58 | 65-71 68 | 62-69 65 | 83-83 50 |
| Witch grass (<i>Triticum repens</i>), | 2 | 4 | 60-63 61 | 61-64 62 | - | 49-64 58 | 56-68 62 | 62-70 66 | 54-60 57 |
| Buttercups (<i>Ranunculus acris</i>), | 1 | 2 | 56 | 57 | - | 56 | 41 | 67 | 70 |
| White weed (<i>Leucanthemum vulgare</i>), | 1 | 2 | 58 | 58 | - | 58 | 46 | 67 | 62 |
| IV.—ROOTS AND TUBERS. | | | | | | | | | |
| Potatoes, | 1 | 3 | 73-80 77 | 75-81 78 | - | 43-45 44 | - | 87-93 91 | - 13 |
| Sugar beets, | 1 | 2 | 94-95 95 | 98-100 99 | - | 90-93 91 | 88-113 100 | 100-100 100 | 40-53 50 |
| Mangolds, | 1 | 2 | 77-80 79 | 83-87 85 | - | 70-80 75 | 27-59 43 | 91-92 91 | - |
| English fiat turnips, | 1 | 2 | 91-95 93 | 93-99 96 | - | 84-95 90 | 89-117 100 | 96-97 97 | 82-92 88 |
| Ruta-bagas, | 1 | 2 | 84-90 87 | 89-93 91 | - | 75-86 80 | 61-87 74 | 94-95 95 | 77-92 84 |
| V.—CONCENTRATED FEED STUFFS. | | | | | | | | | |
| (a) Protein Feeds. | | | | | | | | | |
| Cotton-seed meal, | 2 | 6 | 67-82 76 | - | - | 88-96 88 | - 32 | 44-75 64 | 87-100 93 |
| Cotton-seed, raw, | 1 | 2 | 63-69 66 | - | - | 66-70 68 | 65-86 76 | 49-50 50 | - 57 |
| Cotton-seed, roasted, | 1 | 2 | 53-58 56 | - | - | 44-50 47 | 62-69 66 | 50-53 51 | 68-75 72 |

* Four hulls to 1 meal.

Experiments with Ruminants — Continued.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen-free Extract (Per Cent.). | Fat (Per Cent.). |
|--|---------------------------|----------------|-------------------------|-----------------------------|------------------|----------------------|--------------------|------------------------------------|------------------|
| V.—CONCENTRATED FEED STUFFS— <i>Con.</i> | | | | | | | | | |
| (a) <i>Protein Feeds—Con.</i> | | | | | | | | | |
| Cleveland flax meal, | 3 | 9 | 76—88 83 | 79 | — | 83 | — | 79 | 87 |
| New-process linseed meal, | 1 | 3 | 73—83 78 | — | — | 82—88 85 | 49—100 74 | 82—87 84 | 90—98 93 |
| Average last two, | 4 | 12 | 81 | — | — | 84 | — | 80 | 89 |
| Old-process linseed meal, | 1 | 3 | 75—82 79 | — | — | 86—93 89 | 33—71 57 | 76—79 78 | 85—92 89 |
| Chicago gluten meal, | 1 | 2 | 87—89 88 | — | — | 87—91 89 | — | 93—94 93 | 92—94 93 |
| King gluten meal, | 1 | 2 | 79—82 81 | — | — | 91 | — | 78—81 79 | 91—97 94 |
| Cream gluten meal, | 1 | 2 | 92—95 93 | — | — | 83—84 84 | — | 85—91 88 | 96—99 98 |
| Average all gluten meals, | 4 | 8 | 87 | — | — | 88 | — | 88 | 93 |
| Gluten feed, | 5 | 11 | 85 | — | — | 85 | 76 | 89 | 83 |
| Germ oil meal, | 2 | 5 | 72—83 76 | 75 | — | 65—77 73 | — | 68—82 76 | 95—98 96 |
| Chicago maize feed, | 1 | 2 | 83—85 84 | — | — | 83—84 84 | 68—76 72 | 84—87 85 | 90—90 90 |

| | | | | | | | | |
|---|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Dried distillery grains, brand R, | 1 | 56-59 58 | - | - | 56-63 59 | - ? | 61-73 67 | 80-88 84 |
| Dried distillery grains, X brands, | 4 | 81 | - | - | 74 | ? | 82 | 95 |
| Dried distillery grains, Atlas gluten meal, | 1 | 80-80 80 | - | - | 73-73 73 | - ? | 84-85 84 | 90-92 91 |
| Dried brewers' grains, | 1 | 62-62 62 | - | - | 78-81 79 | 50-55 53 | 59-59 59 | 89-93 91 |
| Malt sprouts, | 1 | 67 | 68 | - | 80 | 34 | 69 | 100 |
| H-O dairy feed, | 1 | 64-67 65 | - | - | 76-80 78 | 39-43 41 | 67-73 70 | 83-88 85 |
| Pea meal, | 1 | 85-88 87 | 86-89 88 | - | 80-86 83 | 25-26 26 | 93-94 94 | 52-57 55 |
| Soy bean meal, | 2 | 75-79 78 | - | - | 89-91 90 | 0-73 33 | 68-73 71 | 81-98 89 |
| Cow-pea meal, | 1 | 85-88 87 | - | 22-45 33 | 80-85 82 | 62-66 64 | 92-94 93 | 74-74 74 |
| Wheat bran, spring, | 1 | 62-63 63 | - | - | 78-82 80 | 22-25 24 | 70-71 70 | 76-76 76 |
| Wheat bran, winter, | 1 | 57-66 62 | - | - | 75-79 77 | - 27 | 62-76 65 | 51-80 64 |
| Wheat bran, average all trials, | 8 | 62 | 62 | - | 77 | 21 | 69 | 66 |
| Wheat middlings, standard, | 2 | - | 73 | 25 | 77 | 30 | 78 | 88 |
| Wheat middlings, flour, | 1 | 79-86 83 | - | - | 82-88 85 | 33-40 36 | 84-91 88 | 82-88 85 |
| Mixed feed, adulterated with corn cobs, | 1 | 59-65 62 | 61-67 64 | 28-34 31 | 62-63 63 | 17-36 28 | 68-74 71 | 91-93 92 |
| Rye feed, bran and middlings, | 1 | 77-83 82 | - | 25-48 35 | 78-82 80 | - | 86-89 88 | 79-99 90 |

Experiments with Ruminants — Concluded.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen-free Extract (Per Cent.). | Fat (Per Cent.). |
|---|---------------------------|----------------|-------------------------|-----------------------------|------------------|----------------------|--------------------|------------------------------------|------------------|
| V. — CONCENTRATED FEED STUFFS — <i>Con.</i> | | | | | | | | | |
| (b) <i>Starchy feeds.</i> | | | | | | | | | |
| Corn meal, | 5 | 14 { | 83—98 89 | — | — | 40—87 70 | — | 85—100 94 | 71—99 91 |
| Corn and cob meal, | 1 | 3 { | 74—83 79 | — | — | 43—65 52 | 2—86 45 | 86—91 88 | 82—85 84 |
| Kafir corn meal, | 2 | 5 { | 54—76 66 | — | — | 36—62 53 | — | 67—84 77 | 25—62 46 |
| Kafir corn, unground, | 2 | 6 { | 29—58 43 | — | — | 28—54 41 | — | 34—62 45 | — |
| White Kafir heads, | 1 | 4 { | 14—35 24 | — | 24—83 54 | 7—23 12 | 0—46 27 | 14—40 31 | 5—65 31 |
| Cerealine feed, | 1 | 3 { | 89—92 90 | — | — | 79—81 80 | 72—92 82 | 93—97 95 | 78—83 81 |
| Oats, unground, | 2 | 6 { | 66—74 70 | 68—74 71 | 2—61 25 | 72—81 77 | 15—40 31 | 74—79 77 | 87—92 89 |
| Rice meal, | 1 | 2 { | 71—76 74 | — | — | — | — | 89—95 92 | 91—92 91 |
| Rye meal, | 1 | 2 { | 85—90 87 | — | — | 83—85 84 | — | 89—94 92 | 63—65 64 |
| Corn bran, | 2 | 4 { | 70—71 70 | — | — | 53—55 54 | 50—65 59 | 74—80 77 | 69—85 77 |
| Rice bran, | 1 | 2 { | 63—66 65 | — | 1—4 2 | 58—68 63 | 16—42 29 | 76—81 78 | 85—92 89 |

| | | | | | | | | | | | | | | |
|-------------------------------|---|---|---|---|---|---|---|------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Chop feed, largely corn bran, | . | . | . | . | . | 2 | 6 | { 71—92 80 | — | — | 56—77 67 | 54—70 62 | 64—92 84 | 61—86 82 |
| H-O horse feed, | . | . | . | . | . | 2 | 3 | { 70—77 74 | 78 | — | 71—81 75 | — | 79—84 82 | 74—87 81 |
| Corn and oat feed, Victor, | . | . | . | . | . | 1 | 3 | { 74—76 75 | — | — | 66—75 71 | 36—58 48 | 81—85 83 | 84—88 87 |
| Oat feed, Quaker, | . | . | . | . | . | 2 | 6 | 62 | 52 | — | 72 | 55 | 55 | 72 |
| Oat feed, Royal, | . | . | . | . | . | 1 | 3 | { 42—51 47 | 42—53 48 | 33—40 37 | 64—72 69 | 20—43 33 | 50—54 51 | 86—92 88 |
| Oat feed, excessive hulls, | . | . | . | . | . | 1 | 3 | { 20—38 34 | — | 8—21 13 | 51—69 62 | 25—37 32 | 29—36 33 | 80—97 92 |
| Oat feed, average last two, | . | . | . | . | . | 2 | 6 | 40 | — | 25 | 65 | 32 | 42 | 90 |
| Peanut feed, | . | . | . | . | . | 1 | 2 | { 32—32 32 | — | — | 70—71 71 | 10—13 12 | 41—58 49 | 90—90 90 |
| Corn cobs, sheep, | . | . | . | . | . | 1 | 2 | { 59—60 59 | — | — | 13—22 17 | 65—66 65 | 60—60 60 | 44—56 50 |

Experiments with Swine.

| | | | | | | | | | | | | | | |
|---------------------------|---|---|---|---|---|---|---|------------------|-------------|------------|-------------|-------------|-------------|-------------|
| Barley meal, | . | . | . | . | . | 1 | 1 | 80 | 80 | — | 81 | 49 | 87 | 57 |
| Maize kernels, whole, | . | . | . | . | . | 1 | 1 | 83 | 83 | — | 69 | 38 | 89 | 46 |
| Maize meal, | . | . | . | . | . | 2 | 2 | { 89—90 90 | 91—92 92 | — | 86—90 88 | 20—49 39 | 94—94 94 | 75—82 80 |
| Maize meal, with cobs, | . | . | . | . | . | 1 | 1 | 76 | 77 | — | 76 | 29 | 84 | 82 |
| Old-process linseed meal, | . | . | . | . | . | 1 | 4 | { 76—79 77 | — | 8—12 10 | 83—90 86 | 10—14 12 | 82—87 85 | 75—82 80 |
| Pea meal, | . | . | . | . | . | 1 | 1 | 90 | 92 | — | 80 | 78 | 95 | 50 |

Experiments with Swine — Concluded.

| KIND OF FODDER. | Number of Different Lots. | Single Trials. | Dry Matter (Per Cent.). | Organic Matter (Per Cent.). | Ash (Per Cent.). | Protein (Per Cent.). | Fibre (Per Cent.). | Nitrogen-free Extract (Per Cent.). | Fat (Per Cent.). |
|-------------------------------------|---------------------------|----------------|-------------------------|-----------------------------|------------------|----------------------|--------------------|------------------------------------|------------------|
| Potatoes, | 1 | 4 | 97 | - | - | 84 | - | 98 | - |
| Wheat, whole, | 1 | ? | 72 | - | - | 70 | 30 | 74 | 60 |
| Wheat, cracked, | 1 | ? | 82 | - | - | 80 | 60 | 83 | 70 |
| Wheat shorts (middlings), | 1 | 2 | 74-79 77 | - | - | 71-75 73 | 25-48 37 | 85-88 87 | - |
| Wheat bran, | 1 | 2 | 54-78 66 | - | - | 74-76 75 | 30-39 34 | 56-75 66 | 65-78 72 |

Experiments with Horses.

| | | | | | | | | | |
|--|---|---|-------------|---|-------------|-------------|-------------|-------------|-------------|
| Corn, whole, | 1 | 2 | 71-78 74 | - | 20-32 26 | 40-76 58 | - | 85-92 88 | 43-52 48 |
| Corn meal, same as above, | 1 | 2 | 84-93 88 | - | - | 74-77 76 | - | 93-99 96 | 70-76 73 |
| New corn product, | 1 | 2 | 40-59 50 | - | 6-37 22 | 65-70 68 | 38-71 55 | 39-54 47 | 48-72 60 |
| Oats, whole, | 1 | 2 | 67-77 72 | - | 31-36 33 | 84-87 86 | 13-49 31 | 75-83 79 | 80-85 82 |
| Oats, ground, same as above, | 1 | 2 | 73-78 76 | - | 9-49 29 | 81-83 82 | .6-28 14 | 85-87 86 | 79-81 80 |

Literature. — The following publications have been consulted in compiling the foregoing tables of digestibility : —

Colorado Experiment Station, Bulletin 8.

Connecticut (Storrs) Experiment Station, reports for 1894–96, 1898.

Hatch (Massachusetts) Experiment Station, reports for 1895–99, 1901 ; Bulletin 50 and in unpublished records.

Illinois Experiment Station, Bulletins 43, 58.

Kansas Experiment Station, Bulletin 103.

Maine Experiment Station, reports for 1886–91, 1893, 1894, 1897, 1898, 1900.

Maryland Experiment Station, Bulletins 20, 41, 43, 51.

Massachusetts State Experiment Station, reports for 1893, 1894.

Minnesota Experiment Station, reports for 1894–96 ; Bulletins 26, 36, 42, 47.

Mississippi Experiment Station, report for 1895.

New York Experiment Station, reports for 1884, 1888, 1889 ; Bulletin 141.

North Carolina Experiment Station, Bulletins 80c, 81, 87d, 97, 118, 148, 160, 172.

Oklahoma Experiment Station, Bulletins 37, 46.

Oregon Experiment Station, Bulletins 6, 47.

Pennsylvania Experiment Station, reports for 1887–94, 1897, 1898.

Texas Experiment Station, Bulletins 13, 15, 19.

Utah Experiment Station, Bulletins 16, 54, 58.

Wisconsin Experiment Station, report for 1889 ; Bulletin 3.

INDEX.

| | PAGE |
|--|---------|
| Agriculturist, report of, | 11-56 |
| Alfalfa as a forage crop, | 52 |
| fertilizers used for, | 53 |
| yields on Field B, | 54 |
| yield, with and without lime, | 54 |
| Analysis of animal excrement, | 120 |
| ashes, meals, marls, lime, compounds, etc., | 111-113 |
| chemicals, refuse salts, etc., | 110 |
| dairy products, | 193 |
| fruits, | 133 |
| garden crops, | 135 |
| guanos, phosphates, | 118 |
| insecticides, | 147 |
| refuse substances, | 113-119 |
| Asparagus rust in Massachusetts, | 69 |
| Aster stem rot, | 68 |
| Barley, relative yield on muriate and sulfate of potash, | 18 |
| Beets, table, nitrogen fertilizers for, | 22 |
| Birches (cut leaved), dying of, | 58 |
| Bone-black, dissolved, effect on grass crop, | 37 |
| promotes ripening of onions, | 41 |
| renders use of lime less needed for onions, | 41 |
| steamed, slower in action than raw, | 29 |
| Botanist, report of, | 57-85 |
| Brazilian millet, the same as pearl millet, | 56 |
| Brown-tail moth, | 87 |
| Cabbages, muriate <i>v.</i> sulfate of potash for, | 19 |
| phosphates for, | 18 |
| relative yield on muriate and sulfate of potash, | 23 |
| Carbonate of potash for wheat and corn, | 30, 31 |
| Carnation stem rot, | 67 |
| Cattle feed inspection, | 152 |
| Chrysanthemum rust in Massachusetts, | 59-61 |
| stem rust, | 67 |
| Clover, good on phosphate and potash, | 19 |
| proportion in mowings affected by fertilizer, | 38 |
| relative yield on muriate and sulfate of potash, | 19 |
| COEFFICIENTS OF DIGESTIBILITY OF AMERICAN FEED STUFFS: | |
| experiments with horses, | 214 |
| poultry, | 214 |
| ruminants, | 196-212 |
| swine, | 213 |
| Composition and digestibility of concentrated feeds, | 181 |
| green fodder, | 182 |
| hay and dry, coarse fodders, | 177 |
| silage, | 177 |
| vegetables, fruit, etc., | 180 |

| | PAGE |
|---|---------|
| Corn, crops on manure alone <i>v.</i> crops on manure and potash, | 42, 43 |
| ensilage, food value of different varieties, products of equal areas, | 34 |
| ensilage variety test, | 32-34 |
| Corn, potash-rich fertilizers for, | 43 |
| relative yields, manure spread in winter or in spring, | 48 |
| Dairy legislation, | 156 |
| Desiccation, effects of, on soil, | 62 |
| Elm-leaf beetle, | 87 |
| Feed, effect of, on composition of milk, | 162-168 |
| on consistency of body of butter, | 162-168 |
| Fertilizer ingredients of fodder articles, | 188-192 |
| FERTILIZERS : | |
| effect of, on proportion of clover in mowings, | 38 |
| for garden crops, | 20 |
| special, affected by experiment station results, | 43-46 |
| Florida phosphate, a slow-acting fertilizer, | 29 |
| FUNGI : | |
| affecting elm, | 58 |
| linden, | 58 |
| maple, | 58 |
| oak, | 57 |
| sterilization of soil in greenhouses for, | 74-85 |
| Garden crops, fertilizers for, | 20 |
| sulfate <i>v.</i> muriate of potash for, | 23 |
| Grass, soil test with, | 35 |
| yields on different fertilizers, | 35, 36 |
| Gypsy moth, | 87 |
| Hay and rowen, yields on fertilizers rich in potash, | 36 |
| Hay, yield on manure alone compared with yield on manure and potash, | 46 |
| Insecticides, analysis of, | 147 |
| Kainite for wheat and corn, | 30, 31 |
| Lime, effects on yields of onions in soil test, | 39 |
| most useful with muriate of potash and nitrate of soda, | 41 |
| yields of alfalfa with and without, | 53, 54 |
| Mand's Wonder forage crop, the same as pearl millet. | 56 |
| Manufacturers and dealers taking out certificates, | 99 |
| Manure alone <i>v.</i> manure and potash, | 42 |
| and potash, more profitable than manure alone, | 43 |
| application of, previous history of plots, | 48 |
| time of application, | 50 |
| time of application of, yields of corn and millet, | 51 |
| use in soil test, | 35 |
| MELON DISEASES : | |
| anthracnose, | 63-66 |
| blight, | 63-66 |
| downy mildew, | 63-66 |
| Millet, pearl, false names of, | 56 |
| relative yields, manure spread in winter or in spring, | 51 |
| Nitrate of soda as nitrogen fertilizer, superior value of, | 20 |
| effect on grass crop, | 37 |
| for rowen, | 47 |
| sulfate of ammonia and dried blood for garden crops, | 20 |
| Nursery inspection, | 87 |
| Onions, ripening favored by dissolved bone-black, | 41 |
| soil test with, | 39 |
| yields with and without lime, | 41 |

| | PAGE |
|--|---------|
| Pearl millet, identical with so-called Mand's Wonder and Brazilian, | 56 |
| Phosphates, different, compared on basis of equal phosphoric acid, | 28 |
| equal money's worth compared, | 28 |
| for cabbages and turnips, yields and relative standing, | 27 |
| for field crops, relative efficiency, | 30 |
| for oats, yields and relative standing, | 26 |
| for onions, yields on different, | 29 |
| natural, good crops possible with, | 24 |
| relative value of different, | 21 |
| Phosphoric acid, etc., found in fruits, etc., | 142 |
| Potash, fertilizers rich in, compared with special corn fertilizers, | 43 |
| fertilizers rich in, for corn, | 45 |
| highly essential for onions, | 41 |
| largely increases rowen crops, | 48 |
| muriate compared with sulfate, | 17 |
| sulfate superior for early crops, | 22 |
| sulfate v. muriate for garden crops, | 23 |
| Potassium oxide, etc., found in fruits, etc., | 142 |
| Potatoes, relative yield on muriate and sulfate of potash, | 18 |
| REPORTS : | |
| chemist (fertilizers), | 91-148 |
| chemist (foods and feeding), | 149-216 |
| entomologist, | 86-88 |
| meteorologist, | 89, 90 |
| treasurer, | 9, 10 |
| Rowen, much better when potash fertilizers are used, | 45 |
| nitrate of soda for, | 47 |
| San José scale, | 88 |
| Slag, phosphatic, a good fertilizer, | 29 |
| Soil, effects of desiccation on, | 62 |
| sterilization of, in greenhouses for fungous diseases, | 74 |
| Soil tests, fertilizers used in, | 34 |
| Soil test with onions, | 39 |
| Sterilization of soil in greenhouses for fungous diseases, | 74 |
| Summer forage crops, notes on, | 169 |



